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ABSTRACT

This study is concerned with the manner in which experience with concrete, quantitative, interpersonal, and verbal content influences the development of ability patterns in first grade children. The literature related to theoretical models of intellectual development indicates that abilities develop in response to experiential variables, such as content, and that content specific instruction may experimentally produce changes in the ability patterns of six-year-olds. Pilot studes were conducted and data to test the experimental hypotheses were collected from 240 first grade children. A Seriation Skills Test, which is included in the document, was prepared from these. A Solomon Four Group Designs used to ensure internal validity of the study and the effect of instruction on subtest scores and total scores was assessed by performing an analysis of variance of group means observed on posttest. The results revealed high pretest intercorrelations among some seriation abilities and low pretest intercorrelations among others, and instruction did not significantly alter the relationships. The results suggest that to improve the reliability of infant and preschool intelligence scales and to select materials for home intervention and Head Start programs, Structure of Intellect content categories should be used as guides. (MBM)

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RELATIONSHIPS BETWEEN CONTENT EXPERIENCE AND THE DEVELOPMENT OF SERIATION SKILLS IN FIRST GRADE CHILDREN

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June 25, 1970

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RELATIONSHIPS BETWEEN CONTENT EXPERIENCE AND THE DEVELOPMENT OF SERIATION SKILLS IN FIRST GRADE CHILDREN

by

Lewis Alfred Bonney

Summary

The study investigated the role of content experiences in the development of children's abilities. A review of literature suggested that children accumulate differing amounts of experience with concrete, quantitative, interpersonal and verbal materials resulting in differential skills for processing these types of content. It seemed reasonable to attribute individual differences in ability for processing different types of content to differing amounts of experience with the various types of content.

The study was designed to observe the nature of children's ability patterns and the role of content-relevant instruction in modifying these ability patterns. Two questions were raised: (1) Do seriation skills generalize across content categories?, and (2) Will a brief period of content relevant instruction alter the extent to which seriation skills generalize across content categories? These questions became two hypotheses: (1) There will be no significant relationships among the abilities of children to seriate concrete, quantitative, interpersonal and verbal content; and (2) Following content-relevant instruction with each type of content, there will be a significant increase in the relationship among the abilities of children to seriate concrete, quantitative, interpersonal and verbal content.

Data were collected from 201 children enrolled in ten first

grade classrooms in three low SES level neighborhood elementary schools. Seriation abilities were measured with a specially constructed Seriation Skills Test. Instruction was conducted outside the classroom in small groups by experienced first grade teachers, using materials representative of the content categories. Each child was exposed to one and one-half hours of instruction with each type of content.

The Seriation Skills Test proved reasonably reliable and a Solomon Four Group experimental design indicated that the experiment had good control of internal validity factors. The treatment (instruction) was the only factor significantly contributing to variance in test scores.

The data revealed high pretest intercorrelations among some seriation abilities and low pretest intercorrelations among other seriation abilities. There were relatively high correlations observed between children's seriation abilities as measured by scores on (1) concrete and quantitative subtests ($r = .42$), (2) concrete and interpersonal subtests ($r = .34$), and (3) quantitative and interpersonal subtests ($r = .42$). There were relatively low correlations observed between children's scores on (1) concrete and verbal subtests ($r = .15$), (2) quantitative and verbal subtests ($r = .19$), and (3) interpersonal and verbal subtests ($r = .17$). The "high" correlations among children's abilities were statistically significant at or beyond the .05 level of confidence, and the "low" correlations were significant at the .10 level of confidence.

The "high" correlation coefficients were interpreted as reflecting either (1) a tendency for seriation skills to generalize across content categories, or (2) correlated background experiences, or (3) psychologically indistinct content categories. The "low" correlations were interpreted as supporting the notion of independent development of abilities for processing various types of content.

The data further revealed that instruction did not significantly alter the relationship among children's abilities to seriate the various types of content. Although instruction did significantly raise the level of student scores on the Seriation Skills Test, it had virtually no effect on the correlation between children's scores on (1) concrete and interpersonal subtests (pretest $r = .34$; post test $r = .35$), (2) quantitative and interpersonal subtests (pretest $r = .42$; post test $r = .44$), and (3) quantitative and verbal subtests (pretest $r = .10$; post test $r = .22$). Instruction had a more pronounced effect on the relationships among children's abilities to seriate (1) concrete and quantitative content (pretest $r = .42$; post test $r = .56$), (2) concrete and verbal content (pretest $r = .15$; post test $r = .33$), and (3) interpersonal and verbal content (pretest $r = .17$; post test

r = .35). These changes were not, however, statistically significant.

The failure of instruction to significantly alter relationships among abilities to seriate various types of content was interpreted as consistent with Guilford's notion of independent abilities for each type of content. Content relevant instruction apparently did not operate in a manner to accelerate the development of poorly developed abilities. Rather, instruction had more or less the same effect on each ability, resulting in approximately equal rates of development for both the relatively well and relatively poorly developed abilities.

The instances in which instruction had a noticeable effect on relationships among abilities were interpreted as suggesting that content relevant experiences have the potential to influence ability development. It may be that the $4\frac{1}{2}$ hours of content relevant instruction differentially affected ability development but was of insufficient duration to generate statistically significant changes in relationships among abilities.

The study offers some evidence inconsistent with Piaget's concept of accomodation. Assuming children accumulate differing amounts of experience with concrete, quantitative, interpersonal and verbal materials, the theory implies that accomodation should have occurred for those materials in which children had experience, while accomodation should not have occurred to the same extent for unfamiliar materials. Intervention in the form of content relevant instruction should accelerate accomodation to unfamiliar materials and result in more evenly developed abilities. The investigation revealed some low intercorrelation among abilities which may have reflected differential degrees of accomodation or refinement of intellectual structure; however, content relevant instruction did not significantly alter the relationships among seriation abilities. Ability patterns remained the same following instruction. The implication is that a brief content relevant instructional period may not be sufficient for prompting accomodation to new materials and fostering the transfer of intellectual processes across content categories.

The study offers only limited support for the assumption, imbedded in process-oriented curriculum, that intellectual processes transfer from one content category to another. The findings of the present study reveal some tendency for the intellectual process of seriation to generalize across content categories; however, there were also some low intercorrelations among seriation abilities suggesting lact of generalization. Further, there is only limited evidence that exposure to unfamiliar materials fosters transfer of abilities to the new type of material. The implication is that people designing process-oriented curriculum should use psychologically meaningful content categories as a framework for selecting materials to use in instructional units. Intellectual processes systematically developed with materials chosen from each content category would be applicable to the categories of content which factor analysis has suggested are psychologically meaningful within Western culture.

The results are pertinent to the reliability of infant and

pre-school intelligence scales. Stott and Ball (1965) have collected evidence indicating that the low reliability of infant and preschool mental tests can be traced to changing factor composition of various age levels. They identified the Structure of Intellect factors which describe test items at each age level of the Stanford-Binet, California Infant Scale, the Cattell Infant Intelligence Scale, the Gesell Developmental Schedules, and the Merrill-Palmer Scale. They concluded that one reason for change in a child's mental age scores at different age levels is that, due to the changing content, the child is being tested for different abilities at the different age levels. The findings of the present study, demonstrating low intercorrelations among seriation abilities as applied to different types of content, confirm Stott and Ball's conclusion that, as one changes test content, one should expect little correlation among abilities. The implication is that persons interested in constructing reliable infant and preschool intelligence tests should use materials representative of each content category at each age level.

Persons interested in selecting materials for home intervention programs and Head Start programs would similarly be well advised to use Structure of Intellect content categories as a framework for guiding their choices. In the past, decisions regarding curriculum materials have been guided by efforts to duplicate circumstances found to be associated with early intellectual development, such as trips to museums, mealtime conversations, and stable adult male figures. A more sophisticated approach would include factor analytic studies of the process and content factors underlying impoverished and enriched backgrounds. If process and content factors could be isolated, curriculum decisions could be based on the essential ingredients of experience rather than a haphazard duplication of circumstances. The findings of the present study indicated that considerations of content factors is essential in the design of programs intended to develop intellectual processes useful in a wide variety of situations.

To the extent that the content of test or curriculum materials does represent an important dimension of individual differences, it may be of value to group children on the basis of their proficiency in dealing with various types of content. For example, children might be grouped on the basis of their skill in dealing with interpersonal situations or their skill in handling quantitative or symbolic concepts. Tests similar to the Seriation Skills Test could be developed to measure levels of proficiency in applying a given intellectual process to various types of content. Information from these measures could be used to group children and individualize instruction in a manner to enhance the development of relatively weak abilities. This sort of grouping would be useful in providing the specific content-relevant remediation, which findings of the present study suggest may be necessary to compensate for uneven ability patterns.

The analysis of data from the present study has identified some desirable refinements of measuring instruments and some areas for further investigation.

It is recommended that the Seriation Skills Test be refined by making the content categories more similar to Guilford's Structure of Intellect categories.

Additional studies might deal with the following issues: (a) Do intellectual processes--such as inference, hypotheses formulation and data interpretation--generalize across Structure of Intellect content categories? (b) What sort of instruction is useful in prompting transfer from one content category to another? (c) What is the factor content of those experiences and circumstances associated with early intellectual development?

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CHAPTER I

INTRODUCTION TO THE STUDY

This chapter describes children's ability patterns, identifies some experiential correlates of ability patterns, and proposes a procedure for intervening in the development of abilities. A research problem is formally stated and hypotheses are derived for directing an experimental study.

The Nature of Ability Patterns

Young children commonly demonstrate an uneven pattern of abilities. Some may demonstrate a high level of skill in solving mechanical problems but have poor interpersonal skills. Others may excel in manipulating their peers but have limited skill in manipulating numbers. Still others may have a well-developed capacity for formulating verbal concepts but a less well-developed capacity for grasping quantitative or mechanical concepts. According to Cornbach (1963), individual's verbal and arithmetical abilities tend to correlate about .40. Lesser, Fifer, and Clark (1965) report a correlation of .32 between spatial and numerical abilities in six-year-olds. Stevenson et al. (1968) report that student scores on discrimination learning of line drawings correlate only .27 with discrimination learning of geometrical forms. These moderate to low correlations reflect uneven ability patterns and suggest that some factors are operating in a manner to differentially affect the development of abilities.

Experiential Correlates of Uneven Ability Patterns

The role of experience in stimulating the development of abilities has been the subject of numerous studies (Riesen 1958, Thompson and Heron 1954, Rheingold and Bayley 1959). More recently, Bruner (1966) has demonstrated that the nature of one's experience is related to the pattern of one's abilities. He has shown that the abilities of children from a variety of cultures tend to develop in response to cultural demands. While children of rural and urban cultures initially group objects on the basis of concrete, immediately perceivable characteristics, urban children soon respond to the content of their more complex environment by beginning to group objects on the basis of symbolic, abstract characteristics. Rural children whose adaptational problems remain more concrete continue to group objects on the basis of concrete characteristics. A similar comparison was made between schooled and unschooled children. Schooled children respond to the highly verbal "telling out of context" environment of school by developing skills in thinking with abstract, symbolic content. Unschooled children, who learn in the context of doing, develop abilities for thinking with concrete content. It seems that an individual's ability patterns can be related to the content of his experience.

Lesser et al. (1965) have collected evidence indicating that the

contrasting cultural milieu presented by different ethnic groups fosters distinctly different ability patterns. They studied ability patterns of Chinese, Negro, Jewish, and Puerto Rican ethnic groups. Members of low and middle class socioeconomic levels were included in each ethnic sample. The abilities studied were: verbal ability, reasoning, number facility, and space conceptualization. Their results revealed (1) significant differences between the two social class groups in level of score on each mental ability, (2) significant differences among the four ethnic groups in level of score for each mental ability, (3) significant interaction between social class and ethnicity in determining the level of scores for each mental ability, and (4) significant differences among the four ethnic groups in pattern of scores on the four mental ability scales. They stated (p.83):

> Ethnic group affiliation strongly affects the pattern of organization of mental abilities, but once the pattern specific to the ethnic group emerges, social class differences within the ethnic group do not alter this basic organization.

They concluded by stating that "mediators associated with ethnicity provide differentiated impacts upon the development of mental abilities." The study indicates that the content of one's experiences influences the patterns of one's abilities.

Compensation for Uneven Ability Patterns

The present study is concerned with investigating the role of content experiences in influencing the development of abilities. It may be that experience with a given type of content is necessary for development of a capacity for processing or problem solving with that type of content. If experience with a given type of content is related to the development of abilities for handling that type of content, it should be possible to accelerate the development of deficient abilities by the provision of suitable, content-oriented experiences.

This would be consistent with Jean Piaget's (Piaget and Inhelder 1964, Flavell 1963) conception of cognitive development. He views cognitive development as proceeding through a series of qualitative changes in intellectual structures. The structures change in response to experiences of the organism. The content of an organism's past experiences influences the types of material which intellectual structures can organize and process. Structures are changed by accommodating or modifying their organizational properties in accordance with initially incongruent sensory imputs. Structures may be developed for performing a given operation, for example, classification, on a given type of content, such as concrete or figural. These structures would not, however, be able to classify verbal content until some verbal experiences had been accumulated. Experience with a given type of content is regarded as prerequisite to developing structures for processing that type of content.

On the basis of Piaget's theory, it seems reasonable to speculate

that training experiences with an appropriate type of content might alter ability patterns. Abilities which were initially slow in development might be accelerated by provision of appropriate content-oriented experiences. For example, an individual observed to have a well-developed ability for classifying verbal content might demonstrate a more even pattern of abilities following exposure to verbal experiences. In this instance, verbal experiences would be conceived as accelerating verbal classification ability to a level commensurate with that of concrete classification ability. The observed result would be an increased correlation between concrete classification ability and verbal classification ability.

The role of content experiences in stimulating the development of content-oriented abilities can be initially investigated by observing the extent to which an ability for processing one type of content transfers to other types of content. This requires a measuring instrument in which task is held constant and content varied.

Seriation is a task applicable to many types of content. Seriation is the ability required for ordering or sequencing objects of events in place or time. It is possible to perform the operation of seriation on concrete, quantitative, interpersonal and verbal content.

Statement of the Problem

This study is concerned with the manner in which experience influences the development of ability patterns. It focuses on the role of experience with concrete, quantitative, interpersonal and verbal content in stimulating the development of abilities for handing these types of content. It is particularly concerned with the relationships among first grade children's abilities to seriate or sequence each type of content.

The study investigates the following questions:

1. Do seriation skills generalize across content categories? Is so, there should be statistically significant intercorrelations among children's abilities to seriate concrete, quantitative, interpersonal and verbal content.

2. Will a brief training period with materials representative of the content categories alter the extent to which seriation skills generalize across the content categories? If so, there should be significantly increased intercorrelations among seriation abilities following training.

Hypotheses

Hypotheses related to the first question are:

1a. There will be no significant relationship between the ability of children to seriate concrete materials and the ability of children to seriate quantitative materials prior to training.

1b. There will be no significant relationship between the

ability of children to seriate concrete materials and the ability of children to seriate interpersonal materials prior to training.

1c. There will be no significant relationship between the ability of children to seriate concrete materials and the ability of children to seriate verbal materials prior to training.

1d. There will be no significant relationship between the ability of children to seriate quantitative materials and the ability of children to seriate interpersonal materials prior to training.

1e. There will be no significant relationship between the ability of children to seriate quantitative materials and the ability of children to seriate verbal materials prior to training.

1f. There will be no significant relationship between the ability of children to seriate verbal materials and the ability of children to seriate interpersonal materials prior to training.

Hypotheses related to the second question:

1a. Following training experiences with materials representative of the content categories, there will be a significant increase in the relationship between the ability of children to seriate concrete materials and the ability of children to seriate quantitative materials.

1b. Following training experiences with materials representative of the content categories, there will be a significant increase in the relationship between the ability of children to seriate concrete materials and the ability of children to seriate interpersonal materials.

2c. Following training experiences with materials representative of the content categories, there will be a significant increase in the relationship between the ability of children to seriate concrete materials and the ability of children to seriate verbal materials.

2d. Following training experiences with materials representative of the content categories, there will be a significant increase in the relationship between the ability of children to seriate quantitative materials and the ability of children to seriate verbal materials.

2e. Following training experiences with materials representative of the content categories, there will be a significant increase in the relationship between the ability of children to seriate quantitative materials and the ability of children to seriate interpersonal materials.

2f. Following training experiences with materials representative of the content categories, there will be a significant increase in the relationship between the ability of children to seriate interpersonal materials and the ability of children to seriate verbal materials.

Definition of Terms

The study employs the following special definitions of terms:

An ability is a well-developed strategy or set for performing an intellectual operation on a specific type of content. The empirical referent is performing a structured task with a specified set of materials.

Seriation is the ability required for imposing hierarchial

order on the environment. It is observed when an individual performs the task of sequencing a group of materials.

Content is a culturally relevant system of categories used to describe information about the environment. The categories of content used in the present study are: concrete, quantitative, interpersonal and verbal.

The category of content labeled concrete includes information about physical dimensions of objects, such as size, color and shape.

The category of content labeled quantitative includes information about the aggregate amount of objects or frequency of events.

The category of content labeled interpersonal includes information about affectional relationships between people.

The category of content labeled verbal includes information about linguistic descriptions of objects or events.

Assumptions and Limitations

The study assumes that in growing up a young child accumulates a different amount of experience with concrete, quantitative, interpersonal and verbal content.

The study is limited by the reliability and validity of testing instruments, and findings are restricted to populations similar to the populations from which the experimental sample was drawn.

Justification

The study investigates the validity of Piaget's concept of accommodation. Piaget's theoretical formulations imply that a person who can seriate concrete material has the potential for seriating quantitative, verbal and interpersonal content but may not be able to process these latter types of content with equal facility due to lack of appropriate experiences. The provision of meaningful training experiences should stimulate accommodation and result in a more even development of seriation abilities across content categories. This would be observed as higher correlations among seriation abilities following training.

The study attempts a new perspective on the observation familiar to curriculum designers, that abilities vary across content categories. In other studies (Guilford 1967) tasks have been developed to measure abilities which were subsequently factor analyzed to determine content factors. The usual practice of selecting a battery of tests and factor analyzing student scores to determine how the tests cluster regarding content tends to cloud the relationship between test and content because no effort is made to observe how one test or task can be applied across content categories. While evidence is provided regarding the common factor content of a group of tests, no information is offered regarding the application of specific intellectual processes to different types of content. The present study holds task constant and varies content in an effort to discover the relative levels of development of an intellectual process, seriation, as applied to four content

categories. Information regarding the relative levels of development of abilities for dealing with the four types of content can provide the basis for a more meaningful individualization of instruction.

Information regarding the role of content experiences in fostering the development of abilities useful in academic settings could be of value in designing home intervention programs and preschool curriculum to meet the needs of children unprepared experientially to benefit from the school academic environment. If experience with concrete, quantitative, interpersonal and verbal materials is an important variable in the development of well-balanced ability patterns, a compensatory curriculum should be directed to these content areas.

The study will be of interest to school systems implementing process-oriented curriculum. The intent of these curriculum is to develop intellectual processes or abilities applicable in all of the subject matter areas. For example, processes such as observation, classification, hypothesis formulation and data interpretation are applicable to the materials and phenomena studies in science, social studies and mathematics. Process curriculum use a variety of materials to foster transfer of intellectual processes from one content area to another; however, there is little evidence that the materials used are representative of psychologically meaningful content categories or that intellectual processes do generalize across content categories. The present study investigates the extent to which one intellectual process, seriation, generalizes across content categories. The results will hold implications for the extent to which other intellectual processes should be expected to generalize across content categories.

CHAPTER II

REVIEW OF LITERATURE

This chapter discusses theoretical models of intellectual development, the role of content factors in the development of abilities and the nature of six year old intelligence.

Theoretical Models of Intellectual Development

Several models of intellectual development can be identified in the literature. Intellectual development has been variously conceived as (1) genetically determined, (2) involving the accretion of S-R connections, (3) an elaboration of mediating responses, and (4) involving changes in structural properties.

Arnold Jensen's (Jensen and Deutsch 1968) re-examination of the nature-nurture issue has provided some insights regarding the genetic determinants of intelligence. He has studied the relative contributions of genetic and nongenetic factors to individual differences in measured intelligence. He states (p. 9):

> The largest and methodologically most adequate studies conducted in England and the United States have yielded heritability estimates for intelligence in the range from 0.70 to 0.90. This means that in the various populations studied, between 70 and 90 percent of the variability in measured intelligence is attributable to genetic factors and between 5 and 25 percent to environmental factors . . ."

In other words, 70 to 90 percent of the variance among phenotypes is attributable to variance among genotypes. This leaves little room for experiential factors to influence intellectual development.

The connectionist viewpoint was initially articulated by Edward L. Thorndike (1911) in his classic monograph, Animal Intelligence. Following careful observation of animal learning, Thorndike concluded that learning involved a gradual "stamping in" of stimulus response connections. If a stimulus led to a response, followed by a satisfying state of affairs, a bond was forged making the S-R connection available in subsequent situations. Intellectual development was conceived as essentially an incremental process.

Skinner (in Hill 1963) has distinguished two types of stimulus-response learning. The first involves reflexes and classical conditioning. The second involves instrumental learning of which responses lead to reinforcement in a given situation. In both of these instances learning consists of accruing a repertoire of S-R and R-S connections. This repertoire is developed through selective reinforcement.

Hull (in Hilgard 1956) postulated the existence of mediating responses to account for the development of flexible insightful behavior. Rather than relying entirely on external stimulation to account for behavior, Hull suggested that some responses produced internal stimuli to guide behavior. These stimuli are not directly observable, but can be inferred from observation of flexible behavior not immediately under control of the external stimulus situation. An example is the fractional antedating goal responses. These are anticipatory responses which occur on first sight of the goal and produce stimuli to guide the animal to the goal. Using these stimulus guides the animal can approach the goal by unfamiliar routes, thus acquiring flexibility of behavior.

The concept of mediating responses has been used by several other theorists to account for the development of flexible, insightful behavior. Guthrie (in Hill 1963) employs the term movement-produced-stimuli to account for flexibility in behavior. Miller (in Hill 1963) notes that an individual's emotional responses can produce stimuli to guide behavior. Tolman's (in Hill 1963) sign gestalt learning involves reacting to signs that food is near. These signs in Tolman's system are clearly internal reactions to previous experience in a goal situation. The signs are organized into cognitive maps which guide behavior around obstacles and provide for maximum flexibility in reaching goals. In each instance the mediating responses are acquired through experience or practice in a specific situation. Experience in a situation is considered prerequisite to developing flexible behavior patterns in that situation.

There are two kinds of mediating responses. The first, discussed above, was conceived as involving response-produced stimuli. The second is an observing response. This is a response that changes the external stimulation one receives. Examples are seen in dogs pricking up their ears or in persons focusing their attention on relevant aspects of a situation.

Observing responses are a type of mediating response that guide attention to pertinent cues. These responses can be used to explain the learning involved in acquired distinctiveness of cues. For example, in reading, children must learn to respond to the shape rather than the size of letters. Following experience in reading situation, mediating responses develop for guiding attention to the relevant cues. Initial difficulty in dealing with unfamiliar situations or materials can be attributed to lack of distinctiveness of cues. Given some experience with the situation or materials, mediating responses are elaborated for focusing attention on relevant cues and guiding behavior toward problem solution. Intellectual development in this framework involves the elaboration of an increasingly refined, and widely applicable, system of mediating responses.

Learning sets are another example of mediating responses. Harlow (1949) demonstrated that monkeys acquire sets for learning discrimination problems. In a series of problems in which several objects

are presented and one object repeatedly rewarded regardless of position, the monkeys soon develop a systematic approach. They vary their behavior until they discover the critical objects and then repeatedly respond to that object. In another series of problems, several objects are presented and the one in a particular position is always rewarded regardless of shape. The monkeys soon learn to vary their choice until they discover which position is critical and then repeatedly respond to that position regardless of which object occupies the position. In these situations, monkeys learn how to solve a particular type of problem. They learn from experience which cues are important and respond by focusing their attention on these cues. It should be noted that acquired distinctiveness of cues in these situations requires some experience with the situations and/or materials to be used in subsequent learning problems. If the animals were unfamiliar with the situation or materials, they would have no basis or rationale for directing their attention.

Ausubel (1960) has experimentally demonstrated the importance of mediating responses or advance organizers in human learning. He found that the advance introduction of mediating concepts in the form of substantive materials of a high conceptual nature facilitated the learning of unfamiliar but meaningful verbal material. Experience with mediating concepts relevant to unfamiliar material enhanced both initial learning and retention. This indicates that intellectual development can be fostered by the deliberate introduction of appropriate content specific mediating concepts.

Robert Gagne (1968) conceives of intellectual development as involving the accumulation of learning strategies. In order to apply the job description--task analysis approach to learning problems, one asks "what do individuals have to be able to do to perform successfully in a task?" This leads to the identification of a hierarchy of learning strategies or sets involved in mastering the task. Intellectual development is viewed as the progressive mastery of learning strategies ranging from stimulus-response associations through multiple discriminations to concept formation and problem solving.

The notion that intellectual development involves accumulation of learning strategies has led to process-oriented curricula. In commenting upon Science--A Process Approach, Gagne (in Jensen and Deutsch 1968, p. 50) says,

> The new science aims at a progressive growth in such skills as inferring, predicting, observing, graphing and hypothesizing. . . . The most striking characteristic of these materials is that they are intended to teach children the processes of science rather than what may be called science content. The performances in which these skills are applied involve objects and events of the natural world; the children do, therefore, acquire information from various sciences as they proceed. The goal, however, is not an accumulation of knowledge about any particular domain, such as physics, biology, or chemistry, but competence in the use of the processes that are basic to all science.

The implication is that processes developed for one type of materials will generalize to other types of materials; however, this inference has not been empirically investigated.

Bruner (1966) has drawn attention to developmental changes in the manner in which organisms represent reality. He considers the individual to be inherently capable of representing the world according to three modes; however, the modes actually employed by individuals depend upon the types of problems they encounter in adapting to their ecological niches. A person existing in a rural subsistence culture will tend to interact with his environment on a concrete level. His modes of representing reality may not develop past the imagery stage. This is in part due to the fact that his adaptational problems are stated in concrete terms and also that his culture probably doesn't include highly abstract conceptualization of agricultural knowledge. On the other hand, an individual existing in a technical culture will be faced with more abstract problems, such as the equivalence of money to time and will be more inclined to develop abstract modes of thought. The development of abstract modes of thought by persons in technical cultures will be fostered by the probable presence of abstract linguistic concepts within the culture.

This viewpoint serves to identify the content of one's cultural experiences as an important variable in cognitive development. It implies that an individual who has not been exposed to a given type of content, such as abstract concepts, will not have developed capacities for handling that type of content. He would, however, be viewed as possessing the capacity for abstract thought and would be expected to develop conceptual abilities given experiences utilizing abstract concepts.

Bruner's (1966) notion that a person's modes of representing reality change during development has led to a spiral curriculum. Bruner (1965, p. 45) has organized materials in a manner approximately commensurate with the individual mode of representing reality. As Bruner says,

> Any domain of knowledge can be represented in three ways: by a set of actions appropriate for achieving a certain result (enactive representation), by a set of summary images or graphics that stand for a concept without defining it fully (ikonic representation); and by a set of logical propositions drawn from a symbolic system that is governed by rules or laws for forming and transforming propositions (symbolic representation).

In a spiral curriculum, facts and ideas are successively presented at higher levels of abstraction. Children are encouraged to utilize intellectual processes at or just beyond their development level in organizing and applying curriculum content. As intellectual processes at one level of development (e.g., ikonic) prove lacking in power for handling ideas and abstractions, the child is prompted to differentiate the intellectual processes of the next level of development.

According to Piaget (in Flavell 1963), intellectual development involves changes in the organizational properties of intellectual structures. Changes in organizational structures are prompted by interactions with the environment. Interactions may stimulate the development of a structure for organizing and performing operations on concrete content, but fail to stimulate structures for performing similar operations on other types of content.

Piaget uses the concept of horizontal decalage to describe the situation which occurs when structures organized for processing one type of content are inapplicable to other types of content. An example is the observation (Piaget and Inhelder 1964) that concepts related to the invariance of mass are typically achieved a year or two earlier than concepts related to invariance of weight. Operations accomplished with mass cannot be accomplished with weight. Stevenson et al. (1968) report a similar discrepancy in the development of discrimination learning abilities. They report that the discrimination learning of one type of content, line drawings, correlates only .27 with the same operation, discrimination learning, as applied to geometrical forms. In both examples, intellectual operations performed on one type of content are not performed equally well on other types of content.

The concept of accommodation implies that horizontal decalage is related to lack of experience with specific kinds of content. In the two examples above, it would be consistent with the theory to state that structures failed to develop for handling invariance of weight or discrimination learning with geometrical forms due to lack of experience with these types of content.

A different perspective on the nature of intellect is provided by J. P. Guilford (1967) who has identified 120 separate and independent ability factors. Guilford has organized ability factors into a three-dimensional "Structure of Intellect" model. The three dimensions of the cube are operations, contents, and products. An ability is defined by its operation (cognition, memory, divergent production, convergent production or evaluation); its content (figural, symbolic, semantic, or behavioral); and its product (units, classes, relations, systems, transformations, or implications). For example, the ability involved in perceptual speed tasks is defined by the operation of cognition being applied to figural content to yield a unit product. The ability is referred to as cognition of figural units (CFU). As another example, the ability involved in seriation tasks is the operation of convergent production being applied to various types of content to yield hierarchical systems. The ability involved in seriating sticks of various lengths (figural content) would be referred to as convergent production of figural systems (NFS). The ability involved in seriating alphabetical characters (symbolic content) would be referred to as convergent production of symbolic systems (NSS). There two seriation abilities are considered independent because they involve two different types of content. According to the Structure of Intellect model, there should be no correlation between the ability to seriate sticks (NFS) and the ability to seriate letters (NSS).

Guilford's Structure of Intellect model identifies 120 independent abilities. The notion of independence implies that there is no relation between a person's standing on one ability and his standing on any of the other abilities. The intercorrelations among the 120 independent abilities should all be insignificant. A significant correlation between any two of the abilities would cast doubt on the validity of the model.

The Role of Content Factors in the Development of Intellect

Cornbach (1963, p. 242) has stated, "Consistent opportunities to use a type of reasoning or discrimination, with appropriate reward, enhance that activity." The notion that experience with a given type of content enhances abilities for handling that type of content has been supported by a variety of studies.

Ford (1957) observed that Samoans have an uncanny ability to score highly on the Navy test of aptitude for learning radio codes, which calls for memory of rhythmic patterns. He explained this exceptional ability on the basis of the Samoan's experience in singing and dancing to highly complex rhythmic patterns produced by percussion instruments. In this instance experiences with a given sort of content, rhythmic beats, led to highly developed abilities for dealing with rhythmic patterns.

Birch (1945) presented some observations suggesting that for chimpanzees, experiences with a given type of material may be prerequisite to solving problems with the particular type of content. He observed that the only one of the six chimpanzees that succeeded in securing food with a hoe-like tool was the animal which had been observed to use sticks regularly in the spontaneous play.

Whiteman and Deutsch (in Jensen and Deutsch 1968) have identified some experiential correlates of abilities and reading achievement. They studied 165 first and fifth grade children from varying SES levels in New York City. Their data indicate that quality of housing, scholastic aspiration, dinner conversation, cultural activities and Kindergarten are all significantly associated with abilities as measured by the Lorge Thorndike I.Q. Test, the vocabulary subtest of the WISC, and a special orientation test. The background factors most closely associated with reading achievement were interaction activities with parents, mealtime conversations, and visits to zoos and museums. Whiteman and Deutsch(in Jensen and Deutsch 1968, p. 97) comment that

> . . . the correlations between the abilities and the achievement variable, reading, are higher than between environmental conditions and reading. The median correlation between abilities and reading is .64, as compared to a median correlation of .27 between environmental conditions and reading. This suggests that these abilities may be exerting a more direct influence on

reading than the more distant background variable. There is consistency here with the notion that environmental conditions exert their influence on underlying skills which in turn more directly influence the development of reading skills.

This emphasizes the importance of studying environmental factors as related to intellectual processes. It may be that the focus of experiential factors is on basic intellectual processes, such as classification and seriation, rather than on more complex performances such as reading.

Bloom, Davis, and Hess (1965) report a study suggesting that exposure to unfamiliar materials may accelerate the development of abilities for processing these materials. The study investigated visual perceptual ability in Kindergarten children. On a visual discrimination test, in which children matched an abstract form to the same form in a cluster of three forms, upper socioeconomic status children scored significantly higher than lower SES children. The interesting finding was that, following "instruction" in which the children merely looked at the forms projected on a screen, the low SES children made greater gains than the upper SES children on the discrimination task. The final scores of the two SES groups were approximately the same. The study illustrates that (1) lower SES children may have poorly developed perceptual discrimination abilities and that(2) content relevant experiences can accelerate the development of low SES children's perceptual discrimination abilities to a level commensurate with their high SES peers.

An early study by Anastasi (1936) found that content specific instruction can produce changes in mental organization. She developed a group of tests utilizing verbal, numerical, and spatial content. She attempted to minimize the overlap of content between these tests. The scores of preadolescent children produced a pattern of intercorrelations shown in Table 1.

Table 1. Intercorrelations Among Test Scores for Preadolescent Children

	Vocabulary	Digit span	Pattern analysis	Verbal reasoning
1. Vocabulary				
2. Digit span	.21			
3. Pattern analysis	.14	.22		
4. Verbal reasoning	.51	.16	.30	
5. Code manipulation	.24	.39	.31	.53

It should be noted that tests differing in content produced (with two exceptions) uniformly low correlations.

Following instruction specific to each ability, Anastasi found changes in ability patterns. She found an increase in correlation between (1) the abilities for pattern analysis and verbal reasoning (from r = .30 to r = .38) and (2) the abilities for code manipulation and pattern analysis (from r = .31 to r = .52) (Anastasi 1936, p. 350). Her results indicate that content relevant instruction can alter the degree of association among content specific abilities.

The Nature of Six-year-old Intelligence

The nature of six-year-old intelligence can be described in terms of structure or ability factors.

The structural viewpoint, as articulated by Jean Piaget (in Flavell 1963) considers the six-year-old child to be in a transitional period between the pre-operational subperiod and the concrete operations subperiod. The child has acquired the capacity to use signs and symbols in representing the environment. The child can think about objects both with images and with symbols. He is conceived as developing the capacity to perform multiple classifications and consider two dimensions of an object simultaneously. He may not yet have acquired the capacity to conserve or report that mass or volume can remain constant through proportional changes in dimensions. Focusing on seriation skills, the six-year-old child is described by Piaget (Piaget and Szeminska 1952) as being able to categorize sticks by length. He is considered to be in the process of developing the capacity to order the sticks in a staircase effect in which the bottoms are even and the tops of increasing length. The child is conceived as developing the appreciation that each item in a series is both greater than the preceding item and smaller than the one which is to follow.

An alternative perspective on six-year-old intelligence is provided by factorial research. Meyers and Orpet (1962) have distinguished four separate abilities in six-year-olds: Hand-eye coordination, perceptual speed, linguistic, and spatial reasoning. Children can be characterized by their status on each of these abilities. In a later study Meyers and Orpet (1966) identified four independent structures of intellect abilities in six-year-olds: Auditory memory for symbolic units (MSU), convergent semantic production (NM), divergent production of semantic units (DMS), and evaluation of figural units (EFU).

Lesser et al. (1965) found low positive correlations among abilities in six-year-olds. As shown in Table 2, only reasoning and number abilities correlate above .50. It is interesting that those abilities dealing with different content (verbal x number, verbal x space, space x number) show the lowest intercorrelations. This suggests that some factors were operating to differentially affect the development of content-oriented abilities in six-year-olds.

Table 2. Correlation Among Abilities in Six-year-olds.

	Reasoning	Number	Space
Verbal	.46	.37	.32
Reasoning		.61	.47
Number			.35

Summary

This chapter has reviewed literature related to theoretical models of intellectual development, the role of content factors in the development of abilities, and the nature of six-year-old intelligence.

The review indicated that abilities develop in response to experiential variables, such as content, and that content specific instruction may experimentally produce changes in the ability patterns of six-year-old children.

CHAPTER III

PROCEDURES FOR COLLECTING AND ANALYZING THE DATA

This chapter (1) discusses the pilot studies used to develop and refine testing and curriculum materials, (2) identifies the experimental population, (3) describes the final revision of testing and curriculum materials, (4) outlines the experimental design, and (5) details the statistical tests used to assess the experimental hypotheses.

Pilot Studies

The testing and curriculum materials were developed and standardized in a series of pilot studies conducted during the late spring and early fall of 1969. Subjects for the initial pilot were 18 first grade children enrolled in a parochial day school. A trial run of the investigation was subsequently undertaken with 63 children enrolled in a neighborhood elementary school.

The objective of test development was to construct an instrument in which task could be held constant and content varied. Test items in which subjects were asked to seriate or sequence materials representative of each content category were initially developed with the day school students. Items were subsequently refined in the fall with children in a neighborhood elementary school similar in student population to the intended target population.

The objective of curriculum development was to select materials which were representative of concrete, quantitative, interpersonal and verbal content categories. The children at the day school were exposed to a variety of materials representative of each content category. The author's impression of the children's interest in manipulating and labeling the materials was the criterion for inclusion in the initial curriculum units. Materials were added and modified on the basis of experience gained in the fall study.

The rationale underlying instructional techniques was based on the theoretical techniques formulations of Jean Piaget (as described in Sigel and Hooper 1968). The most salient characteristics were: (1) active physical manipulation of materials by students, (2) verbal labeling, and (3) small heterogeneous group instruction. Project teachers experimented with these techniques and refined them in the fall study.

The Sample

Data to test the experimental hypotheses were collected from 240 first grade children attending elementary schools located in mixed racial, low to middle socioeconomic level neighborhoods in a large southwestern city. The children were from 10 classrooms located in three schools in two different school districts.

Measurement

The Seriation Skills Test, developed and standardized in pilot studies, was used to assess children's seriation abilities. The test required the subjects to perform the same task with each of the four types of content.

While the task remained constant, the content of items was selected to correspond with the content categories. Concrete items involved ordering seven balsa wood sticks of varying lengths to form "staircase" patterns. For example, the examiner would order the three shortest sticks from the shortest to the longest, give the subject the remaining four sticks and say, "Now you put these sticks in order to finish the staircase." Quantitative items required the subjects to rearrange cups containing various numbers of marbles to form sequences ranging from, "the cup with the smallest number of marbles to the cup with the largest number of marbles". Interpersonal items were similar to the WISC picture arrangement task and required subjects to order a group of separately mounted pictures in a manner, "to tell a story". Verbal items required subjects to tell sequential stories having, "a beginning, a middle and an end". The interested reader will find a detailed description of test items in the Examiner's Manual in Appendix A.

The final revision of the Seriation Skills Test included eight items in each of the four content categories. The items were scored right or wrong, so it was possible to obtain a maximum score of 8 on each subtest and a maximum total score of 32. The Examiner's Manual in Appendix A details the procedure for scoring each item.

The Seriation Skills Test was individually administered by four female graduate students in rehabilitation counseling. Testing time varied according to the number of correct responses. The range in testing time was approximately 10 to 30 minutes.

Curriculum Materials

There was a curriculum unit corresponding to each content category. Concrete materials were Cuisenaire rods. These brightly colored wooden rods of varying lengths could be arranged in ascending and descending patterns. Also, two small rods could be fitted together to make a combination exactly equal to a longer rod. Quantitative materials were specially constructed, brightly colored peg abacuses. It was possible to place different numbers of large washers on the pegs. Children could place one washer on the first peg, two washers on the second peg, etc. Interpersonal materials were independently mounted series of pictures cut out of elementary workbooks. The pictures could be arranged to tell a story. Verbal materials were colored pictures of children at school and in common neighborhood activities. Children were asked to tell sequential stories about the pictures.

Teaching Methods

The seven project teachers were all experienced with primary age

children. They removed the children from the classroom and instructed them in groups of 5 for 30 minute periods twice per week. One week was alloted for work with each type of material, and there was one review period with each category of material for a total of 6 weeks of instruction. Each child received a total of 6 hours of instruction. The children were randomly assigned to groups. In instructional sessions, teachers asked children to actively manipulate and verbally label the materials. The teachers encouraged the use of words such as, "biggest", "middle sized", "smallest", "first", "middle", "last", "before", "after", and "next".

Experimental Design

The study relied upon a Solomon Four Group Design (Campbell and Stanley 1963) to insure internal validity. The design, graphically illustrated in Figure 1, provided for (1) an assessment of treatment effects, (2) an assessment of possible relationships between pretest and treatment, and (3) an assessment of possible relationships between pretest and post test. Children in each of the 10 sample classrooms were randomly distributed to one of the experimental groups. It can be seen that children in Group I received pretest, treatment and post test, children in Group II received treatment and post test, children in Group III received pretest and post test, children in Group IV received only post test. The disproportionally large distribution of subjects to Group I stems from the consideration that only subjects in Group I were used to test experimental hypotheses. Subjects in the other groups were controls used to assess internal validity of the experiment. The uneven numbers of subjects in the other groups is the result of experimental attrition. The first day of instruction it was discovered that 6 pretested Group I subjects had left school. In order to maintain Group I, 6 pretested subjects from Group III were randomly selected for transfer to Group I. Additional subjects were lost during the course of the investigation as the result of the usual sicknesses and family moves.

The random assignment of subjects to groups was accomplished by numbering the children in each classroom and entering a table of random numbers to determine which children to enroll in experimental and control groups. The first 10 usable numbers encountered in the table designated subjects in Group I, the second 5 numbers designated subjects in Group II, the third 5 numbers designated subjects in Group III, and the fourth 5 numbers designated subjects in Group IV. As some classrooms did not contain 25 students and others contained more than 25, some classrooms had one control condition inadequately represented while other classrooms contained a few students not used in the study. The actual number of subjects initially allotted from each classroom to each experimental condition is indicated in Appendix C.

Those subjects designated for pretesting were individually administered the Seriation Skills Test in the period February 23 through March 20, 1970. Testing order was randomly determined and testers were arbitrarily assigned to subjects by always taking the next subject on the master testing list. Instruction lasted for six weeks and

R	I	O_1	X	O_2	n = 96
R	II		X	O_3	n = 34
R	III	O_4		O_5	n = 29
R	IV			O_6	n = 42

Figure 1

SOLOMON FOUR GROUP DESIGN

Roman numerals = 4 treatment groups or experimental conditions.
R = subjects randomly assigned to the groups.
O = observations or administrations of the test battery.
X = treatments or, in the case of the present study, training designed to provide experiences with each type of content.
n = number of subjects per group.

occurred between March 23 and April 30, 1970. Post testing was accomplished between May 4 and May 29, 1970.

Statistical Analysis

The effect of treatment (instruction) on subtest scores and total scores was assessed by performing an analysis of variance of group means observed on post test.

Specific sources of variance were investigated by making the following comparisons:

1. Treatment variance was assessed by comparing the pooled average of means observed in groups which had the treatment (Groups I and II, O_2 and O_3) with the pooled average of means observed in groups which did not have the treatment (Groups III and IV, O_5 and O_6).
2. The interaction of pretest and treatment was assessed by comparing the mean of the group which had pretest and treatment (Group I, O_2) with the mean of the group which had no pretest but did receive the treatment (Group II, O_3).
3. The interaction of pretest and post test was assessed by comparing the mean of the group which had pretest and post test (Group III, O_5) with the mean of the group which had only the post test (Group IV, O_6).

Following these explorations of the internal validity of the experiment, the hypotheses were tested by focusing on subjects in Group I.

Hypotheses 1a to 1f were assessed by computing the six correlation coefficients representing the pretest relationships between seriation skills for the four types of content. The six correlation coefficients reflected the relationships between the ability to seriate (1) concrete and quantitative content, (2) concrete and interpersonal content, (3) concrete and verbal content, (4) quantitative and interpersonal content, (5) quantitative and verbal content, and (6) interpersonal and verbal content. These coefficients were based on the data obtained for Group I in O_1 (see Figure 1).

In the present investigation it was desirable to detect evidence of relationships among children's abilities to seriate concrete, quantitative, interpersonal and verbal materials. The literature review had suggested that correlations between abilities might be rather small so it seemed reasonable to adjust the power of statistical tests in a manner to discriminate small departures from chance expectations. In contrast to the usual concern of investigators with minimizing the chances of erroneously concluding that sample values are representative of population parometers, the present investigator was more concerned with enhancing the power of statistical tests to identify existing relationships. Alpha errors were considered less costly than beta errors. Accordingly, alpha levels for rejecting the null hypotheses 1a - 1f were set at the .10 level.

To test the null hypotheses that p, the population correlation, was equal to zero, the following formula (Edwards 1967, p. 246) was utilized:

$$t = \frac{r}{\sqrt{1 - r^2}} \sqrt{n - 2}$$

The t is a ratio whose sampling distribution depends only on the size of n. The r is the correlation coefficient reflecting the relationship between two variables, in the present case, scores on subtests of the Seriation Skills. It was determined from tabled values (Edwards 1967, p. 425) that correlation coefficients greater than .16 (df = 100) were statistically significant at the .10 level for two-tailed tests.

Hypotheses 2a to 2f were tested by (1) computing the six correlation coefficients representing the six post test relationships among the four seriations skills, and (2) assessing the statistical significance of the change in correlation between pretest and post test. The significance of the difference between pretest coefficients and post test coefficients was assessed by transforming the correlation coefficients to Fisher Z' scores (in Edwards 1967, p. 248). Fisher has shown that the distribution of Z' is approximately normal. Since Z' is approximately normally distributed, differences between Z' xcores were expressed as Z scores by dividing by the standard error of the difference. The significance of the Z indicating the amount of the difference

between pretest and post test correlation coefficients was determined by reference to the standard normal table.

The alpha levels for rejecting null hypotheses 2a - 2f were set at the .06 level.

The reliability of the Seriation Skills Test was assessed by computing both test-retest and odd-even split coefficients. The test-retest coefficient was an ordinary product-moment r computed for the 29 subjects in Group III over a 6 week interval. The odd-even split coefficient (a phi coefficient) was computed on the post test scores of 50 randomly selected subjects.

The inter-tester consistency was assessed by performing a one-way analysis of variance on post test scores reported by the four testers.

Calendar for Collection of Data

The following steps were taken in collecting the data: (1) individually pretest subjects in treatment conditions I and III (n = 105), February 23 to March 20, 1970, (2) instruct subjects in treatment conditions I and II (n = 140, 5 subjects per group) for six weeks, March 30 to May 1, 1970, and (3) individually post test all subjects (n = 201), May 4 to May 29, 1970.

Summary

This chapter has (1) described pilot studies, (2) identified the experimental sample; (3) described the measuring instrument, curriculum materials, and teaching methods, (4) presented the experimental design and statistical analyses used in assessing the hypotheses, and (5) outlined a calendar of events for collecting the data.

CHAPTER IV

ANALYSIS OF RESULTS

This chapter presents some considerations related to the internal validity of the experiment, translates the hypotheses into operational and symbolic form, tests the hypotheses, and analyzes the results.

Internal Validity of the Experiment

The Solomon Four Group Design was employed to scrutinize the treatment effect (instruction) and possible interactions between pretest - treatment and pretest - post test. The design, shown in Table 3, rendered the data amenable to an analysis of variance statistical treatment.

Table 3. Experimental Design.

Group	n	Experimental condition		
I	96	Obs.	Instruct	Obs.
II	34		Instruct	Obs.
III	29	Obs.		Obs.
IV	42			Obs.

Analysis 1 assessed the significance of instruction by comparing the pooled average of the post test scores from Group I and Group II with the pooled average of post test scores for Groups III and IV.

Analysis 2 assessed the significance of the interaction between the pretest and instruction by comparing the mean of post test scores for subjects in Group I with the mean of post test scores for subjects in Group II.

Analysis 3 assessed the significance of the interaction between pretest and post test by comparing the mean of post test scores for subjects in Group III with the mean of post test scores for subjects in Group IV.

The results of the analyses of internal validity factors are shown in Table 4. The table entries are F ratios compiled on the raw data obtained in post testing. F ratios are shown for the subject's scores on each subtest and total scores. There was evidence of sig-

nificant treatment effect on the concrete, quantitative and verbal subtests and on the total scores. There was no evidence of significant interaction effects on any of the subtests or total scores. This indicates that instruction was the major factor generating significant changes in subject's test scores.

Those readers interested in the means and standard deviations of subject's scores on each subtest are referred to Appendix B. This data confirms the impression that subjects who received instruction consistently scored higher on post test than subjects in control conditions. It seems reasonable to conclude that instruction was the factor responsible for changes in subject's test scores.

Table 4. The Role of Three Orthogonal Factors in Generating Post Test Scores.

Column 1 is pertinent to the effect of instruction, Column 2 is pertinent to the effect of a possible interaction between pretest and treatment, and Column 3 is pertinent to a possible interaction between pretest and post test. Table entries are F ratios.

Test	Factor (1) Instruction	(2) Interaction pretest-treatment	(3) Interaction pretest-post test
Concrete	6.027*	0.976	1.219
Quantitative	5.027*	0.052	1.801
Interpersonal	0.625	0.317	0.202
Verbal	4.297	1.216	2.320
Total Scores	9.791**	1.126	1.036

* ($p < .05$)
** ($p < .01$)

Reliability of the Data

The reliability of the Seriation Skills Test was analyzed by computing test-retest coefficients and odd-even split coefficients. Test-retest coefficients were computed for each subtest and for total scores. The data was based on 29 cases (Group III) and a time interval of six weeks. The odd-even split was accomplished by computing correlation coefficients between subject's response on the odd and even items of each subtest and for total scores. The data for the odd-even split coefficients was based on the post test scores of 50 randomly selected subjects.

The reliability coefficients for the Seriation Skills Test are presented in Table 5. It can be seen that the concrete subtest was the most reliable and that the verbal was the least reliable.

The data related to inter-tester consistency is presented in Table 6. The table reveals highly significant differences among testers in administering the concrete and verbal subtests. There is an associated significant difference in total scores reported by testers. It seems that identity of tester did make a significant difference in scores obtained by students.

Table 5. Reliability of the Seriation Skills Test.

Test	Reliability Coefficients	
	(Test-retest)	(Odd-even)
Concrete	.73	.59
Quantitative	.76	.52
Interpersonal	.38	.58
Verbal	.24	.37
Total Score	.75	.52

Table 6. Inter-tester Consistency in Administering the Seriation Skills Test. An analysis of variance between mean scores reported by testers on each subtest of the Seriation Skills Test.

Test	F Ratio of difference between mean scores. Reported by four testers.
Concrete	5.08**
Quantitative	1.23
Interpersonal	1.01
Verbal	12.99**
Total Score	4.98** 8.105

** significant beyond .01 level

The randomization procedures used in assigning testers to subjects helped to control for inconsistencies among testers. Subjects were tested in a random sequence. Testers selected students for testing in accordance with an established list. The pairing of tester and subject was arbitrary. Accordingly, the effect of differences between testers should be randomly distributed throughout the data. The differences between testers apparently did not have a systematic effect on the experimental results.

Testing the Hypotheses

This section presents data relevant to the two questions identified in the Statement of Problem:

1. Do seriation skills generalize across content categories?

2. Will a brief training period with materials representative of the content categories alter the extent to which seriation skills generalize across content categories?

The First Question

It will be recalled that the literature review and theoretical rationale predicted moderate to low intercorrelations among children's abilities to seriate different types of content. The acceptance of null hypotheses stating that there will be no significant relationship between seriation skills would be consistent with these predictions.

An observed correlation coefficient that could occur by chance in less than 10 out of 100 samples was considered evidence of a relationship and led to the rejection of the null hypotheses. Correlation coefficients greater than .16 were considered sufficiently strong evidence of a population relationship to warrant rejection of the null hypotheses. The null hypotheses were only considered acceptable if the observed correlation between seriation abilities was sufficiently small (less than .16) to suggest the absence of a meaningful relationship in the population.

Data pertinent to the first question, "Do seriation skills generalize across content categories?," are presented in Table 7. The table lists each hypothesis pertinent to question 1, the correlation coefficient reflecting the degree of association between the abilities involved in the hypothesis and the significance level of the observed relationship.

The hypotheses related to question 1 are translated and tested in the following manner:

Hypothesis 1a.

The operational form is: There will be no significant correlation between the concrete and quantitative abilities of first grade children as measured by subtest scores on the Seriation Skills Test.

Table 7. Intercorrelations Between Seriation Abilities as Measured by the Concrete, Quantitative, Interpersonal, and Verbal Subtests of the Seriation Skills Test.

Hypothesis	Abilities	Correlation Coefficient	t Value[a]
1a	concrete x quantitative	.42	4.45
1b	concrete x interpersonal	.34	3.49
1c	concrete x verbal	.15	1.56
1d	quantitative x interpersonal	.42	4.45
1e	quantitative x verbal	.19	1.87
1f	interpersonal x verbal	.17	1.66

[a]The t values above 1.64 are statistically significant at the .10 level. The t values above 1.96 are significant at the .05 level, and those t values above 2.57 are significant beyond the .01 level of confidence.

The symbolic form is:

H null $r_{xy} = 0.0$

H directional $r_{xy} \neq 0.0$

where r_{xy} is the correlation coefficient between scores on x (concrete content) and scores on y (quantitative content).

Hypothesis 1a was rejected. The data indicated the presence of a significant relationship between children's abilities to seriate concrete and quantitative content. The t value associated with an r of .42 is significant beyond the .01 level of confidence. This suggests that the ability to seriate concrete content is associated with ability to seriate quantitative content. Persons who can readily seriate concrete content tend to be equally proficient in seriating quantitative content.

Hypothesis 1b.

The operational form is:

There will be no significant correlation between the concrete and interpersonal abilities of first grade children as measured by subtest scores on the Seriation Skills Test.

The symbolic form is:

H null $r_{xy} = 0.0$

H directional $r_{xy} \neq 0.0$

Where r_{xy} is the correlation coefficient between scores on x (concrete content) and scores on y (interpersonal content).

Hypothesis 1b was rejected. A sample correlation coefficient of .34 between abilities to seriate concrete and interpersonal content is indicative of a similar relationship in population parameters. The sample value is significant at the .01 level of confidence. Apparently the ability to seriate concrete content is related to the ability to seriate interpersonal content.

Hypothesis 1c.

The operational form is:

There will be no significant correlation between the concrete and verbal abilities of first grade children as measured by subtest scores on the Seriation Skills Test.

The symbolic form is:

H null $r_{xy} = 0.0$

H directional $r_{xy} \neq 0.0$

where r_{xy} is the correlation coefficient between scores on x (concrete content) and y (verbal content).

Hypothesis 1c was accepted. The observed value of the correlation coefficient (r = .15) was sufficiently small to suggest that there was no meaningful relationship between the ability to seriate concrete and verbal content. The data suggested that children's ability to seriate concrete materials was not associated with their ability to seriate verbal materials. The ability to seriate concrete materials appeared to be independent of the ability to seriate verbal materials.

Hypothesis 1d.

The operational form is:

There will be no significant correlation between the quantitative and interpersonal abilities of first grade children as measured by

subtest scores on the Seriation Skills Test.

The symbolic form is:

H null $r_{xy} = 0.0$

H directional $r_{xy} \neq 0.0$

where r_{xy} is the correlation coefficient between scores on x (quantitative content) and y (interpersonal content).

Hypothesis 1d was rejected. A sample correlation coefficient of .42 between the ability to seriate quantitative materials and the ability to seriate interpersonal materials is highly suggestive of a similar relationship between population parameters. The observed correlation coefficient is significant beyond the .01 level of confidence.

Hypothesis 1e.

The operational form :

There will be no significant correlation between the quantitative and verbal abilities of first grade children as measured by subtest scores on the Seriation Skills Test.

The symbolic form :

H null $r_{xy} = 0.0$

H directional $r_{xy} \neq 0.0$

where r_{xy} is the correlation coefficient between scores on x (quantitative content) and scores on y (verbal content).

Hypothesis 1e was rejected. The observed relationship between the ability to seriate quantitative materials and the ability to seriate verbal materials (r = .19) was sufficiently high to warrant rejecting the null hypothesis of no significant relationship. There appeared to be a small but meaningful relationship between abilities for seriating quantitative and verbal materials.

Hypothesis 1f

The operation form is:

There will be no significant correlation between the interpersonal and verbal abilities of first grade children as measured by subtest scores on the Seriation Skills Test.

The symbolic form is:

H null $r_{xy} = 0.0$
H directional $r_{xy} \neq 0.0$

where r_{xy} is the correlation coefficient between scores on x (interpersonal content) and y (verbal content).

Hypothesis 1f was rejected. The observed correlation of .17 between the ability to seriate interpersonal materials and the ability to seriate verbal materials was just sufficiently strong to warrant rejection of the null hypothesis at the .10 level of confidence. There appeared to be a distinguishable relationship between abilities for seriating interpersonal and verbal materials.

In summary, the experimental sample of first grade children yielded evidence of highly significant relationships between children's abilities for seriating (1) concrete and quantitative content, (2) concrete and interpersonal content, and (3) quantitative and interpersonal content. There were much less significant but distinguishable relationships between children's abilities for seriating (1) concrete and verbal content, and (2) quantitative and verbal content. There was evidence that the children's abilities for seriating concrete and verbal content were independent.

The Second Question

"Will a brief training period with materials representative of the content categories alter the extent to which seriation skills generalize across content categories?" This question was investigated by determining the extent to which instruction altered the correlation between abilities as measured by the subtests of the Seriation Skills Test.

Table 8. The Effects of Intervention on the Relationships Among Seriation Abilities for First Grade Children as Measured by Subtests of the Seriation Skills Test.

Hypothesis	Seriation Abilities	Pretest r	Pretest z'	Post Test r	Post Test z'	Difference* (Z = Z'post-Z'pre) / SE diff
2a	conc. x quant.	.42	.49	.56	.63	Z = .96
2b	conc. x interpers.	.34	.35	.35	.36	Z = .007
2c	conc. x verbal	.15	.16	.33	34	Z = 1.23
2d	quant. x interp.	.42	.49	.44	.47	Z = .041
2 e	quant. x verbal	.19	.19	.22	.22	Z = .020
2f	interp. x verbal	.17	.17	.35.	.36	Z = 1.30

* A Z value of 1.64 is significant at the .05 level of confidence.

The data in Table 8 are pertinent to the effect of instruction on the relationship between seriation abilities. The table lists (1) each hypothesis pertinent to question 2, (2) the abilities involved in the hypothesis, (3) the pretest and post test correlations between the abilities, and (4) the significance of any observed change in relationship.

The literature review suggested that content-related instruction might increase the relationships between seriation skills as applied to various types of content. In the present instance, rejection of the null hypotheses would be consistent with theoretical predictions.

The hypotheses pertinent to question 2 were translated into operational and symbolic form and tested with the following results:

Hypothesis 2a.

The operation form is:

Following six hours of small group instruction equally allotted to units dealing with concrete, quantitative, interpersonal, and verbal content, there will be a significant increase in the correlation between the concrete and quantitative abilities of first grade children as measured by subtest scores on the Seriation Skills Test.

The symbolic form is:

H null $\quad Z'$ post $- Z'$ pre $= 0.0$

H directional $\quad Z'$ post $- Z'$ pre $= 0.0$

where Z' is a transformed correlation coefficient computed according to the formula $Z' = \frac{1}{2} \log_e (1 + r) - \log_e (1 - 4)$ (Edwards 1967, p. 248). Z' post refers to the correlation coefficient observed between concrete and quantitative scores following training. Z' pre refers to the correlation coefficient observed between concrete and quantitative scores prior to training.

Hypothesis 2a was accepted. Instruction did not significantly alter the relationship between children's abilities for seriating concrete and quantitative content. An observed pretest correlation coefficient of .42 between children's abilities for seriating concrete and quantitative content was raised by instruction to .56 on post test; however, this elevation in relationship was not statistically significant.

Hypothesis 2b.

The operational form is:

Following six hours of small group instruction equally allotted to units dealing with concrete, quantitative, interpersonal and verbal content, there will be a significant increase in the correlation between the concrete and interpersonal abilities of first grade children as measured by subtest scores on the Seriation Skills Test.

The symbolic form is:

H null $Z'_{post} - Z'_{pre} = 0.0$

H directional $Z'_{post} - Z'_{pre} \neq 0.0$

where Z' is a transformed correlation coefficient computed according to the formula listed above; Z' post refers to the correlation coefficient observed between concrete and interpersonal scores following training. Z' pre refers to the correlation coefficient observed between concrete and interpersonal scores prior to training.

Hypothesis 2b was accepted. There was virtually no change in the relationship between children's abilities to seriate concrete and interpersonal content following instruction. It appeared that content-relevant instruction had no effect on the relationship between children's abilities for seriating concrete and interpersonal content.

Hypothesis 2c.

The operational form is:

Following six hours of small group instruction equally allotted to units dealing with concrete, quantitative, interpersonal and verbal content, there will be a significant increase in the correlation between the concrete and verbal abilities of first grade children as measured by subtest scores on the Seriation Skills Test.

The symbolic form is:

H null $Z'_{post} - Z'_{pre} = 0.0$

H directional $Z'_{post} - Z'_{pre} \neq 0.0$

where Z' is a transformed correlation coefficient computed according to the formula listed above; Z' post refers to the correlation coefficient observed between concrete and verbal scores following training. Z' pre refers to the correlation coefficient observed between concrete and verbal scores prior to training.

Hypothesis 2c was accepted. Although content-relevant instruction did increase the relationship between abilities for seriating concrete and verbal content from $r = .15$ to $r = .33$, this change in relationship was not statistically significant.

Hypothesis 2d.

The operational form is:

Following six hours of small group instruction equally allotted to units dealing with concrete, quantitative, interpersonal and verbal content, there will be a significant increase in the correlation between the quantitative and interpersonal abilities of first grade chil-

dren as measured by subtest scores on the Seriation Skills Test.

The symbolic form is:

H null $Z'_{post} - Z'_{pre} = 0.0$

H directional $Z'_{post} - Z'_{pre} \quad 0.0$

where Z' is a transformed correlation coefficient computed according to the formula listed above; Z' post refers to the correlation coefficient observed between quantitative and verbal scores following training. Z' pre refers to the correlation coefficient observed between quantitative and verbal scores prior to training.

Hypothesis 2d was accepted. There was no significant change in relationship between children's abilities for seriating quantitative and interpersonal content following instruction. Chance variation could easily account for the observed change from a pretest r of .42 to a post test r of .47.

Hypothesis 2e.

The operational form is:

Following six hours of small group instruction equally allotted to units dealing with concrete, quantitative, interpersonal and verbal content, there will be a significant increase in the correlation between the quantitative and verbal abilities of first grade children as measured by subtest scores on the Seriation Skills Test.

The symbolic form is:

H null $Z'_{post} - Z'_{pre} = 0.0$

H directional $Z'_{post} - Z'_{pre} \quad 0.0$

where Z' is a transformed correlation coefficient computed according to the formula listed above; Z' post refers to the correlation coefficient observed between quantitative and verbal scores following training. Z' pre refers to the correlation coefficient observed between quantitative and verbal scores prior to training.

Hypothesis 2e was accepted. There was virtually no change in correlation between quantitative and verbal seriation abilities following instruction. An initial r of .19 changing to a post test r of .22 does not reflect a meaningful change in relationship.

Hypothesis 2f.

The operational form is:

Following six hours of small group instruction equally allotted to units dealing with concrete, quantitative, interpersonal and verbal

content, there will be a significant increase in the correlation between the interpersonal and verbal abilities of first grade children as measured by subtest scores on the Seriation Skills Test.

The symbolic form is:

H null	Z' post - Z' pre = 0.0
H directional	Z' post - Z' pre 0.0

where Z' is a transformed correlation coefficient computed according to the formula listed above; Z' post refers to the correlation coefficient observed between interpersonal and verbal scores following training. Z' pre refers to the correlation coefficient observed between interpersonal and verbal scores prior to training.

Hypothesis 2f was accepted. Instruction increased the correlation between interpersonal and verbal abilities from r = .17 to r = .35; however, this change in extent of relationship was not statistically significant. While content-relevant instruction apparently served to increase the relationship between children's ability to seriate interpersonal and verbal materials, the extent of increase in relationship was not sufficient to warrant rejection of the null hypothesis.

In summary, content-relevant instruction had virtually no effect on the extent of relationship between children's abilities for seriating (1) concrete and interpersonal content, (2) quantitative and interpersonal content, and (3) quantitative and verbal content. Instruction had a distinguishable but less than statistically significant effect on the relationship between children's abilities for seriating (1) concrete and quantitative content, (2) concrete and verbal content, and (3) interpersonal and verbal content. The effect of instruction was consistently one of elevating the extent of relationships among children's abilities for seriating various types of content; however, none of the increases in relationships were statistically significant.

Analysis of Results

The First Question

The high level of confidence associated with the rejection of hypotheses 1a, 1b and 1d suggests that seriation skills do generalize across some content categories. The relatively high correlation coefficients observed between children's abilities to seriate (1) concrete and quantitative content (r = .42), (2) concrete and interpersonal content (r = .34), and (3) quantitative and interpersonal content (r = .42) is indicative of common variance between seriation abilities. It appeared that skill in seriating concrete materials was associated with skill in seriating both quantitative and interpersonal materials. Similarly, for the children in the present study, skill in seriating quantitative materials tended to vary directly with skill in seriating interpersonal materials.

Alternative explanations of the high correlation coefficients are confronted when one considers psychological distinctions between content categories and the possibility of correlated background experiences. The present study's distinctions between content categories may not be psychologically meaningful. The categories are not exactly parallel to Guilford's factorialy distinct content categories. Also, there may be a tendency for persons who accumulate large amounts of experience with concrete content to accumulate similarly large amounts of experience with quantitative and interpersonal content.

Although the decision rules of the present investigation indicated that null hypotheses 1e and 1f should be rejected, it is apparent that correlation coefficients less than .20 certainly don't indicate a very high degree of association between abilities. The observed correlation coefficient of .19 between children's abilities to seriate quantitative and verbal materials indicates that, despite rejection of the null hypothesis of no significant relationship, there is very little tendency for children who score highly on quantitative content to score equally well on verbal content. Similarly, a correlation coefficient of .17 between children's abilities to seriate interpersonal and verbal content reveals little dependency and leaves substantial room for independent variation. There is, however, a sufficiently strong relationship among sample values to suggest a small but significant relationship among population parameters.

The acceptance of null hypothesis 1c indicates that children's abilities for seriating concrete and verbal content are initially independent. The data indicates that there is no reason to believe that children who score highly in seriating concrete content will score highly on verbal content. Conversely, a highly verbal child may be much less proficient when dealing with concrete materials.

While the evidence of high correlations between abilities lends support to the notion that abilities generalize across content categories, the evidence of low correlations among abilities is consistent with Guilford's Structure of Intellect model. The Structure of Intellect model predicts that there will be no association between similar intellectual operations applied to different types of content. The data of the present study revealing low correlations between children's abilities for seriating (1) concrete and verbal content, (2) quantitative and verbal content, and (3) interpersonal and verbal content lend support to Guilford's theoretical model. In these instances, convergent production operations with one type of content demonstrated little relationship with convergent production operations applied to a different type of content.

The evidence of low intercorrelations among seriation abilities is also consistent with the theoretical formulations of Jean Piaget (in Flavell 1963) and Jerome Bruner (1966). According to these theorists, a person must have some experience with a given type of content before developing an ability for processing that type of content. Assuming that children accumulate differing amounts of experience with the four

types of content, one would expect to find abilities developed to different levels. The low pretest intercorrelation among abilities indicated that the level of development of a given ability was not necessarily associated with the level of development of another ability. In the present case, there was some evidence of uneven ability patterns.

In summary, the study yielded conflicting evidence indicating that in some instances seriation skills do generalize across content categories, while in other cases there is very little generalization. The evidence of generalization observed as relatively high correlation coefficients between children's abilities to seriate (1) concrete and quantitative content ($r = .42$), (2) concrete and interpersonal content ($r = .34$) and (3) quantitative and interpersonal content ($r = .42$) was interpreted as supporting the notion of dependence among content oriented abilities. Although the decision rules of the present investigation dictated that relationships among the other abilities should also be considered statistically significant, the low degree of association among children's abilities to seriate (1) concrete and verbal content ($r = .15$), (2) quantitative and verbal content ($r = .19$), and interpersonal and verbal content ($r = .17$) was certainly indicative of much less generalization. The independent nature of these latter abilities was interpreted as consistent with the theoretical formulations of Jean Piaget and Guilford's Structure of Intellect model.

The Second Question

The acceptance of hypotheses 2a - 2f indicated that a brief training period with materials representative of the content categories did not significantly alter the extent to which seriation skills generalize across content categories. Instruction had virtually no effect on the relationship between children's ability to seriate (1) concrete and interpersonal content (pretest $r = .34$; post test $r = .35$), (2) quantitative and interpersonal content (pretest $r = .42$; post test $r = .44$), and (3) quantitative and verbal content (pretest $r = .19$; post test $r = .22$). Instruction has a much greater but still statistically insignificant effect on the relationship between children's ability to seriate (1) concrete and quantitative content (pretest $r = .42$; post test $r = .56$), (2) concrete and verbal content (pretest $r = .15$; post test $r = .33$), and (3) interpersonal and verbal content (pretest $r = .17$; post test $r = .35$).

These results are somewhat inconsistent with Piagetian theory and the literature review which suggested that students initially demonstrating poorly developed seriation skills with one type of content and relatively well developed seriation skills with other types of content would respond to content relevant instruction by readily developing skills which were initially weak. In other words, students would profit more from instruction in areas of weakness than from instruction in areas of strength. While these theoretical notions would predict a closer association between abilities following content relevant instruction, the evidence of the present experiment indicates that for seriation abilities there were no statistically significant

changes in relationships following instruction.

The observation that content-related instruction does not significantly alter the relationships among abilities for seriating various types of content is consistent with Guilford's Structure of Intellect model. The model is predicated on the notion that intellectual operations applied to different types of content are independent. This rationale is supported by the observation that intercorrelations among abilities for seriating different types of content do not significantly change following instruction. This suggests that abilities for seriating different types of content are independent.

Although the decision rules of present investigation indicated that the change in relationship between children's ability to seriate (1) concrete and quantitative content, (2) concrete and verbal content, and (3) interpersonal and verbal content should not be considered significant, it was apparent that instruction was influencing the relationship among abilities. The correlation between children's ability to seriate concrete and quantitative content was raised from $r = .42$ to $r = .56$, the correlation between children's ability to seriate concrete and verbal content was raised from $r = .15$ to $r = .33$, and the correlation between children's ability to seriate interpersonal and verbal content was raised from $r = .17$ to $r = .35$.

The findings that content-relevant instruction can lead to an increase in the relationship between abilities for seriating different types of content is consistent with the notion that abilities generalize across content categories. An increase in association between abilities for seriating two types of content can be taken as evidence that performance on the task transferred or generalized from one content category to another. This suggests that the initially low degree of association was due to an experiential factor and that the abilities are not actually independent.

The increase in association between seriation skills following instruction is similarly consistent with Piaget's (in Flavell 1963) and Bruner's (1966) structural theories. Their models suggest that an ability may develop for seriating one type of content but fail to generalize to other types of content due to lack of experience with the new type of content. This implies that experience with unfamiliar materials should enhance transfer and thereby accelerate the development of abilities for seriating the new materials. In other words, an equal amount of content-relevant instruction should have a disproportionately large effect on abilities for seriating the unfamiliar materials. Following instruction, there would be an increased correlation between abilities for seriating the two types of content. This inference is supported by the observed increase in correlation between abilities for seriating concrete and verbal content and quantitative and verbal content.

In summary, the study again yielded conflicting evidence indicating that in some cases content relevant instruction led to an increase in associations among abilities while in other cases instruction had little effect on the relationships among abilities. The observed (but

statistically insignificant) increase in relationship between children's ability for seriating concrete and quantitative content, concrete and verbal content and interpersonal and verbal content were interpreted as consistent with Piaget's theoretical formulations. The instances in which instruction had virtually no effect on the relationships between children's abilities to seriate concrete and interpersonal content, quantitative and interpersonal content and quantitative and verbal content were interpreted as consistent with Guilford's Structure of Intellect model.

CHAPTER V

SUMMARY, CONCLUSIONS, LIMITATIONS, IMPLICATIONS, AND RECOMMENDATIONS

This chapter (1) summarizes the experimental rationale, procedures and results, (2) lists conclusions of the study, (3) identifies some limitations, (4) offers some implications, and (5) makes some recommendations for further research action.

Summary

The study investigated the role of content experiences in the development of children's abilities. A review of literature suggested that children accumulate differing amounts of experience with concrete, quantitative, interpersonal and verbal materials resulting in differential skills for processing these types of content. It seemed reasonable to attribute individual differences in ability for processing different types of content to differing amounts of experience with the various types of content.

The study was designed to observe the nature of children's ability patterns and the role of content-relevant instruction in modifying these ability patterns. Two questions were raised: (1) Do seriation skills generalize across content categories?, and (2) Will a brief period of content-relevant instruction alter the extent to which seriation skills generalize across content categories? These questions became two hypotheses: (1) There will be no significant relationships among the abilities of children to seriate concrete, quantitative, interpersonal and verbal content; and (2) Following content-relevant instruction with each type of content, there will be a significant increase in the relationship among the abilities of children to seriate concrete, quantitative, interpersonal and verbal content.

Data were collected from 201 children enrolled in ten first grade classrooms in three low SES level neighborhood elementary schools. Seriation abilities were measured with a specially constructed Seriation Skills Test. Instruction was conducted outside the classroom in small groups by experienced first grade teachers, using materials representative of the content categories. Each child was exposed to one and one-half hours of instruction with each type of content.

The Seriation Skills Test proved reasonably reliable and a Solomon Four Group experimental design indicated that the experiment had good control of internal validity factors. The treatment (instruction) was the only factor significantly contributing to variance in test scores.

The data revealed high pretest intercorrelations among some seriation abilities and low pretest intercorrelations among other seriation abilities. There were relatively high correlations observed between children's seriation abilities as measured by scores on (1) concrete and quantitative subtests ($r = .42$), (2) concrete and interpersonal subtests ($r = .34$), and (3) quantitative and interpersonal subtests ($r = .42$). There were relatively low correlations observed between children's scores on (1) concrete and verbal subtests ($r = .15$), (2) quantitative and verbal subtests ($r = .19$), and (3) interpersonal and verbal subtests ($r = .17$). The "high" correlations among children's abilities were statistically significant at or beyond the .05 level of confidence, and the "low" correlations were significant at the .10 level of confidence.

The "high" correlation coefficients were interpreted as reflecting either (1) a tendency for seriation skills to generalize across content categories, or (2) correlated background experiences, or (3) psychologically indistinct content categories. The "low" correlations were interpreted as supporting the notion of independent development of abilities for processing various types of content.

The data further revealed that instruction did not significantly alter the relationships among children's abilities to seriate the various types of content. Although instruction did significantly raise the level of student scores on the Seriation Skills Test, it had virtually no effect on the correlation between children's scores on (1) concrete and interpersonal subtests (pretest $r = .34$; post test $r = .35$), (2) quantitative and interpersonal subtests (pretest $r = .42$; post test $r = .44$), and (3) quantitative and verbal subtests (pretest $r = .19$); post test $r = .22$). Instruction had a more pronounced effect on the relationships among children's abilities to seriate (1) concrete and quantitative content (pretest $r = .42$; post test $r = .56$), (2) concrete and verbal content (pretest $r = .15$; post test $r = .33$), and (3) interpersonal and verbal content (pretest $r = .17$; post test $r = .35$). These changes were not, however, statistically significant.

The failure of instruction to significantly alter relationships among abilities to seriate various types of content was interpreted as consistent with Guilford's notion of independent abilities for each type of content. Content relevant instruction apparently did not operate in a manner to accelerate the development of poorly developed abilities. Rather, instruction had more or less the same effect on each ability, resulting in approximately equal rates of development for both the ralatively well and relatively poorly developed abilities.

The instances in which instruction had a noticeable effect on relationships among abilities were interpreted as suggesting that

content relevant experiences have the potential to influence ability development. It may be that the four and one-half hours of content-relevant instruction differentially affected ability development but was of insufficient duration to generate statistically significant changes in relationships among abilities.

Conclusions

In view of the results of the investigation and within the limitations of the study, the following conclusions appear to be justified:

(1) There is some tendency for seriation skills to generalize across content categories. There were relatively high correlations observed between children's abilities to seriate (1) concrete and quantitative content ($r = .42$), (2) concrete and interpersonal content ($r = .34$), and (3) quantitative and interpersonal content ($r = .42$). On the other hand, there were relatively low correlations observed between children's abilities to seriate concrete and verbal content ($r = .15$), (2) quantitative and verbal content ($r = .19$), and (interpersonal and verbal content ($r = .17$). All of these coefficients were significant at or beyond the .10 level of confidence.

(2) Content relevant instruction is of limited value in modifying relationships among children's abilities to seriate concrete, quantitative, interpersonal and verbal content. Instruction had essentially no effect on the relationships between children's abilities to seriate (1) concrete and interpersonal content (2) quantitative and interpersonal content, and (3) quantitative and verbal content. Conflicting results revealed that instruction did noticeably increase the relationship between children's abilities to seriate (1) concrete and quantitative content, (2) concrete and verbal content, and (3) interpersonal and verbal content. These changes in degree of association were not, however, statistically significant.

Implications

The study offers some evidence inconsistent with Piaget's concept of accomodation. Assuming children accumulate differing amounts of experience with concrete, quantitative, interpersonal and verbal materials, the theory implies that accomodation should have occurred for those materials in which children had experience, while accommodation should not have occurred to the same extent for unfamiliar materials. Intervention in the form of content-relevant instruction should accelerate accommodation to unfamiliar materials and result in

more evenly developed abilities. The investigation revealed some low intercorrelations among abilities which may have reflected differential degrees of accomodation or refinement of intellectual structure; however, content-relevant instruction did not significantly alter the relationships among seriation abilities. Ability patterns remained the same following instruction. The implication is that a brief content-relevant instructional period may not be sufficient for prompting accomodation to new materials and fostering the transfer of intellectual processes across content categories.

The study offers only limited support for the assumption, imbedded in process-oriented curriculum, that intellectual processes transfer from one content category to another. The findings of the present study reveal some tendency for the intellectual process of seriation to generalize across content categories; however, there were also some low intercorrelations among seriation abilities suggesting lact of generalization. Further, there is only limited evidence that exposure to unfamiliar materials fosters transfer of abilities to the new type of material. The implication is that people designing process-oriented curriculum should use psychologically meaningful content categories as a framework for selecting materials to use in instructional units. Intellectual processes systematically developed with materials chosen from each content category would be applicable to the categories of content which factor analysis has suggested are psychologically meaningful within Western culture.

The results are pertinent to the reliability of infant and preschool intelligence scales. Stott and Ball (1965) have collected evidence indicating that the low reliability of infant and preschool mental tests can be traced to changing factor composition of various age levels. They identified the Structure of Intellect factors which describe test items at each age level of the Stanford-Binet, California Infant Scale, the Cattell Infant Intelligence Scale, the Gesell Developmental Schedules, and the Merrill-Palmer Scale. They concluded that one reason for change in a child's mental age scores at different age levels is that, due to the changing content, the child is being tested for different abilities at the different age levels. The findings of the present study, demonstrating low intercorrelations among seriation abilities as applied to different types of content, confirm Stott and Ball's conclusion that, as one changes test content, one should expect little correlation among abilities. The implication is that persons interested in constructing reliable infant and preschool intelligence tests should use materials representative of each content category at each age level.

Perons interested in selecting materials for home intervention programs and Head Start programs would similarly be well advised to use Structure of Intellect content categories as a framework for guiding their choices. In the past, decisions regarding curriculum materials have been guided by efforts to duplicate circumstances found to be associated with early intellectual development, such as trips to museums, mealtime conversations, and stable adult male figures. A more sophisticated approach would include factor analytic studies of

the process and content factors underlying impoverished and enriched backgrounds. If process and content factors could be isolated, curriculum decisions could be based on the essential ingredients of experience rather than a haphazard duplication of circumstances. The findings of the present study indicated that considerations of content factors is essential in the design of programs intended to develop intellectual processes useful in a wide variety of situations.

To the extent that the content of test or curriculum materials does represent an important dimension of individual differences, it may be of value to group children on the basis of their proficiency in dealing with various types of content. For example, children might be grouped on the basis of their skill in dealing with interpersonal situations or their skill in handling quantitative or symbolic concepts. Tests similar to the Seriation Skills Test could be developed to measure level of proficiency in applying a given intellectual process to various types of content. Information from these measures could be used to group children and individualize instruction in a manner to enhance the development of relatively weak abilities. This sort of grouping would be useful in providing the specific content-relevant remediation, which findings of the present study suggest may be necessary to compensate for uneven ability patterns.

Recommendations

The analysis of data from the present study has identified some desirable refinements of measuring instruments and some areas for further investigation.

1. It is recommended that the Seriation Skills Test be refined by making the content categories more similar to Guilford's Structure of Intellect categories.

2. Additional studies might deal with the following issues: (a) Do intellectual processes--such as inference, hypotheses formulation and data interpretation--generalize across Structure of Intellect content categories? (b) What sort of instruction is useful in prompting transfer from one content category to another? (c) What is the factor content of those experiences and circumstances associated with early intellectual development?

APPENDIX A

SERIATION SKILLS TEST

This test is designed to measure children's ability to seriate materials drawn from concrete, quantitative, verbal and interpersonal content categories. Seriation is defined as the ability to impose hierarchial order on the environment. It involves sequencing or ordering objects and events in place or time. The test provides a standardized observation of a child's ability to seriate materials representative of the four content categories.

The test is suitable for use with four to seven year old children. Testing time varies from ten to fifteen menutes with four and five year olds, to as much as forty minutes with seven year olds.

This manual describes test materials and prescribes administrative techniques. A separate scoring sheet is provided for recording answers. Reliability depends in large measure on the examiner's skill in establishing rapport and adhering to prescribed testing methods.

The test yields a score for each type of content and a total score. The maximum score on each content subtest is 8 and the maximum total score is 32. The subtest scores provide an index for comparing a child's skill in seriating concrete, quantitative, verbal and interpersonal content.

In administering the test, the examiner should provide a primary size table and chair and sit opposite the child. The test materials are presented to the child according to the directions given in the following pages.

Manual for Administration

SERIATION SKILLS TEST

For Concrete
Quantitative
Verbal
and
Interpersonal
Content Categories

Lewis A. Bonney
University of Arizona

CONCRETE CONTENT

Materials: Six sets of balsa wood sticks lettered A - G.

Discontinue: Following a score of 1 or less on two consecutive items.

Directions:

Demonstration: Presents set A for the S's casual examination. Say, "LOOK AT ALL THESE STICKS. YOU CAN PICK SOME UP IF YOU WANT TO."

Build a staircase with the sticks saying, "WATCH ME. I'M GOING TO PUT THE STICKS IN ORDER FROM THE SHORTEST TO THE LONGEST." (See Fig. C 1)

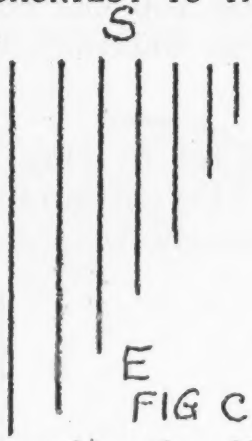


FIG C1

Allow the S to examine the finished demonstration.

Item 1. Pick up all the sticks used in the demonstration and begin a new series with the two shortest sticks. Begin the series at the S's left. (Fig. C 2)

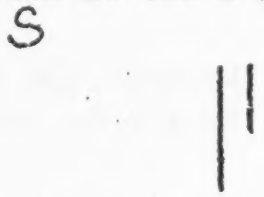


FIG C2

Say, "NOW I'VE STARTED PUTTING THE STICKS IN ORDER AGAIN. YOU FINISH PUTTING THE STICKS IN ORDER FROM THE SHORTEST TO THE LONGEST."

If necessary, coach the child by saying, "WHICH STICK SHOULD COME NEXT?"

Do not offer other cues regarding solution of the problem.

Item 2. Pick up all the sticks and begino a new series with the two longest sticks. The series should begin to the S's left. (Fig. C 3)

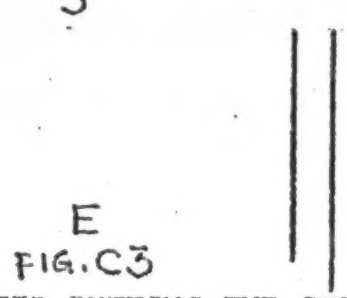


FIG. C3

Say "NOW I'VE STARTED PUTTING THE STICKS IN ORDER FROM LONGEST TO SHORTEST. YOU FINISH THE JOB."

Item 3. Pick up all the sticks and hand them to the S. Say "NOW YOU CAN PUT ALL THE STICKS IN ORDER FROM THE SHORTEST TO THE LONGEST ALL BY YOURSELF."

Item 4. Select set B. Use the subset with the shortest stick ~~(1")~~ to build a staircase with intervals of approximately one inch between sticks. (Fig. C 4)

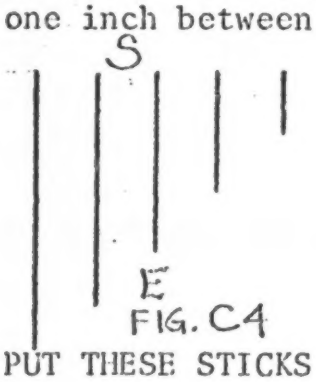


FIG. C4

Say, "LOOK, I'VE PUT THESE STICKS IN ORDER FROM SHORTEST TO THE LONGEST."

Present the remaining subset of five sticks to the S.

Say, NOW YOU FIT THESE STICKS IN BETWEEN MY STICKS. MAKE SURE YOU PUT THEM IN THE RIGHT PLACE SO ALL THE STICKS WILL STILL GO FROM THE SHORTEST TO THE LONGEST.

If necessary, coach the S by taking the shortest of the S's sticks and saying "WHERE WOULD THIS STICK GO?"

If the S doesn't know, place the stick in the proper place and say "THIS STICK GOES HERE. NOW YOU PUT THE REST OF YOUR STICKS IN THE RIGHT PLACE."

Item 5. Select set D.

Present the shorter subset to the S according to the pattern in Fig. C 5.

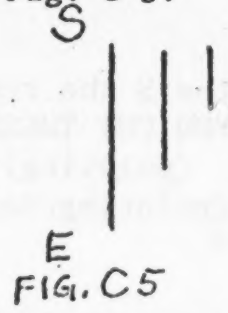


FIG. C5

Say,"LOOK AT THIS SERIES OF STICKS. IN A MINUTE I'M GOING TO BUILD A SERIES LIKE THIS ONE WITH SOME LONGER STICKS."

Arrange the longer subset of D beneath the existing series according to Fig. C 6.

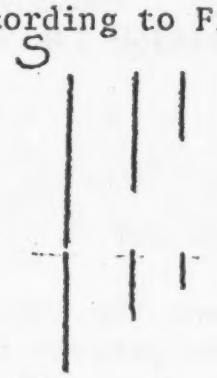


FIG C6

Say,"SEE THE BOTTOM ROW OF STICKS ARE IN A SERIES LIKE THE TOP ROW."

Say, "NOW I'M GOING TO TAKE THE BOTTOM ROW AWAY AND ASK YOU TO PUT THE STICKS BACK IN A SERIES LIKE THE TOP ROW."

Mix up the bottom row and say, "NOW YOU PUT THESE STICK IN A SERIES LIKE THE TOP ROW."

Item 6. Select set E.

Present the shorter subset to the S accoring to the pattern in Fig. C 7.

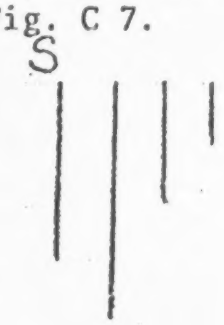


 FIG C7

Say, "LOOK AT THIS SERIES OF STICKS. NOTICE THE LENGTH OF THE STICKS. IN A MINUTE I'LL GIVE YOU FOUR MORE STICKS AND ASK YOU TO PUT THEM IN A SIMILAR SERIES."

Give the S the remaining subset and say, "NOW YOU PUT THESE STICKS IN A SERIES LIKE THESE (pointing). START YOUR ROW RIGHT HERE (pointing to the space beneath the top row)."

If necessary coach the S by taking the shortest stick of the second subset and saying, "WHERE WOULD THIS STICK GO?"

If the S doesn't know, place the shortest stick of subset 2 beneath the shortest stick of subset 1 and say, "THIS STICK GOES HERE. NOW YOU FINISH THE SERIES."

Item 7. Select set F.

Present the shorter subset to the S according to the pattern in Fig. C 8.

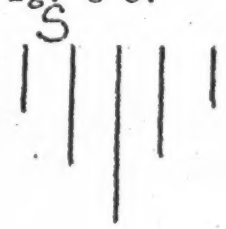


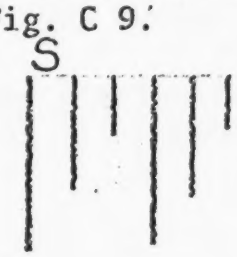
FIG. C8

Say, "LOOK AT THIS SERIES OF STICKS. NOTICE THE LENGTH OF THE STICKS. IN A MINUTE I'LL GIVE YOU FIVE MORE STICKS AND ASK YOU TO PUT THEM IN A SIMILAR SERIES."

Give the S the remaining subset and say, "NOW YOU PUT THESE STICKS IN A SERIES LIKE THESE (pointing). START YOUR ROW RIGHT HERE (pointing to the space beneath the top row)."

Item 8. Select set G.

Present the shorter subset to the S according to the pattern in Fig. C 9.



E

FIG. C9

Say, "LOOK AT THIS SERIES OF STICKS. NOTICE THE LENGTH OF THE STICKS. IN A MINUTE I'LL GIVE YOU SIX MORE STICKS AND ASK YOU TO PUT THEM IN A SIMILAR SERIES."

Give the S the remaining subset and say, "NOW YOU PUT THESE STICKS IN A SERIES LIKE THESE (pointing). START YOUR ROW RIGHT HERE (pointing to the space beneath the top row.)"

QUANTITATIVE CONTENT

Materials: Aluminum cups and marbles.

Discontinue: Following a score of 1 or less on two consecutive items.

Directions:

Demonstration: Present seven cups for S's casual examination. Say, "LOOK AT ALL THESE MARBLES AND CUPS. YOU CAN PICK THEM UP IF YOU WANT TO."

Put one marble in a cup, two marbles in another cup (etc.) until seven marbles are placed in the seventh cup.

Arrange the cups in order from the cup with the smallest number to the cup with the largest number. The series should begin at the S's left. (Fig. Q 1)

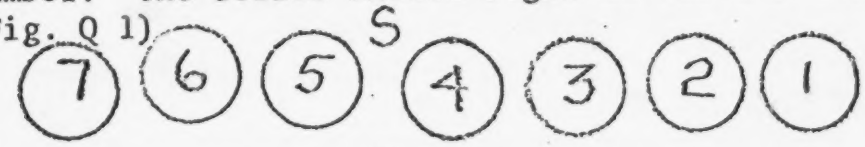


FIG Q1

Say, "WATCH ME, I'M PUTTING THE CUPS IN ORDER FROM THE ONE WITH THE SMALLEST NUMBER TO THE ONE WITH THE LARGEST NUMBER."

Allow the S to examine the finished demonstration.

Item 1. Mix the cups up into a cluster and begin a new series with the cup containing one marble and the cup containing two marbles, The series begins at the S's left (Fig. Q 2)

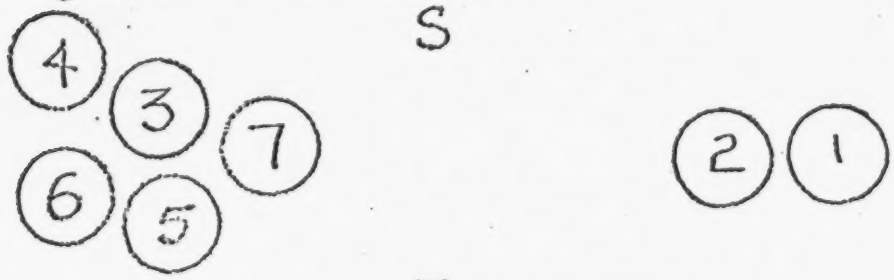


FIG. Q2

Say,"NOW I'VE STARTED PUTTING THE CUPS OF MARBLES IN ORDER AGAIN. YOU FINISH PUTTING THE CUPS IN ORDER FROM THE ONE WITH THE SMALLEST NUMBER OF MARBLES TO THE ONE WITH THE LARGEST NUMBER OF MARBLES."

If necessary, coach the child by saying, "WHICH CUP WOULD COME NEXT?" Show child by re-demonstrating

Do not offer any other cues regarding solution of the problem.

Item 2. Mix up the cups and begin a new series beginning with the cup containing seven marbles and the cup containing six marbles. The series begins at the S's left. (Fig. Q 3)

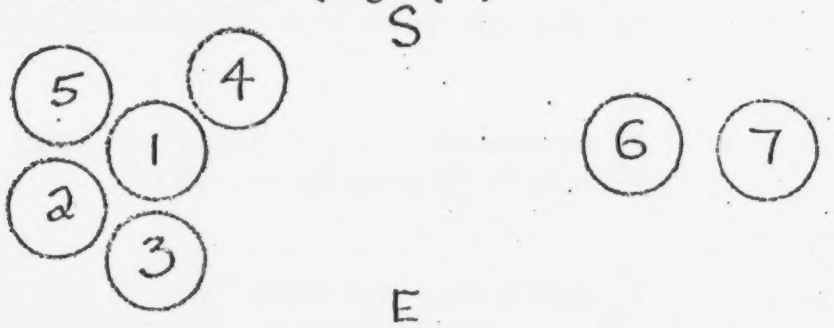


FIG Q3

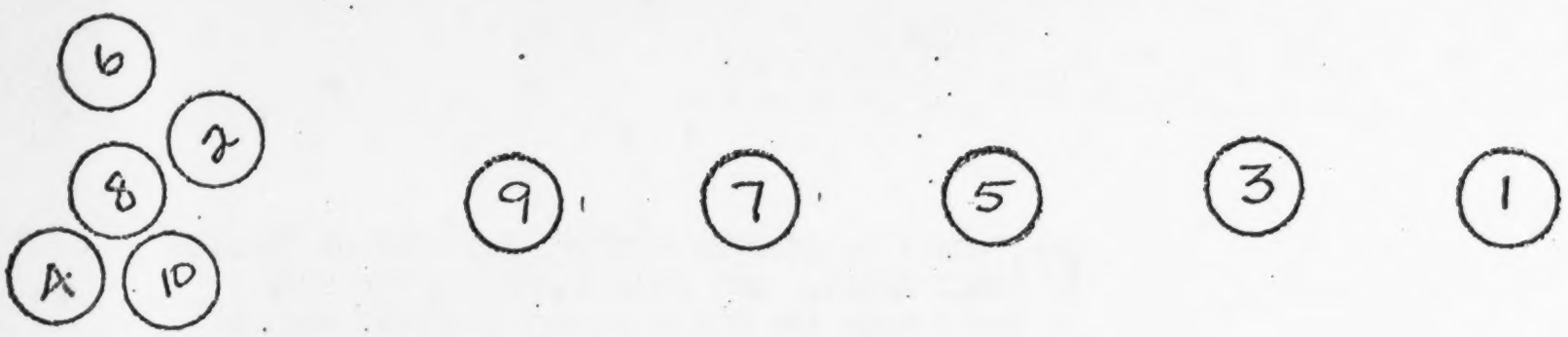
Say, "NOW I'VE STARTED PUTTING THE CUPS IN ORDER FROM ONE WITH THE LARGEST NUMBER OF MARBLES TO THE ONE WITH THE SMALLEST NUMBER OF MARBLES. YOU FINISH THE JOB."

IF NECESSARY THE CHILD MAY BE COACHED AS ABOVE.

Item 3. Mix up all the cups. Say, "NOW YOU PUT THE CUPS IN ORDER FROM THE CUP WITH THE SMALLEST NUMBER OF MARBLES TO THE CUP WITH THE LARGEST NUMBER OF MARBLES.

Item 4. Select ten cups. Fill a cup with each of the following number of marbles: 1,2,3,4,5,6,7,8,9,10.

Arrange the cups with the odd numbers of marbles in order from the cup with the smallest number of marbles to the cup with the largest number of marbles. Leave a space between the cups so that cups with even numbers of marbles can be inserted.(Fig. Q 4)



E

FIG. Q4

Say, "LOOK, I'VE PUT THESE CUPS IN ORDER FROM THE ONE WITH THE SMALLEST NUMBER OF MARBLES TO THE ONE WITH THE LARGEST NUMBER OF MARBLES. I WANT YOU TO FIT THESE OTHER CUPS IN BETWEEN MY CUPS SO THAT ALL THE CUPS WILL BE IN ORDER FROM THE CUP WITH THE SMALLESTNUMBER OF MARBLES. TO THE CUP WITH THE LARGEST NUMBER OF MARBLES."

If necessary, coach the S saying, "WHERE WOULD THIS CUP (two marbles) GO?"

If the S doesn't know, place the cup in the proper place and say, "IT GOES HERE, NOW,YOU PUT THE REST OF THE CUPS IN THE RIGHT PLACE."

Item 5. Fill a cup with each of the following numbers of marbles: 1,2,2,3,4,6.

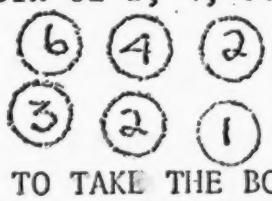
Present three cups to the S according to the pattern in Fig. Q 5.

E

FIG. Q5

Say, "LOOK AT THE NUMBER OF MARBLES IN THE CUPS NOW. IN A MINUTE WE'LL GET THREE MORE CUPS AND PUT THEM IN A SIMILAR SERIES. WE'LL MAKE A WHOLE NEW ROW BENEATH THE ROW I JUST MADE. IT WILL BE THE SAME SORT OF SERIES AS THE TOP ROW."

Arrange the other three cups beneath the first two in a pattern of 2, 4, 6.

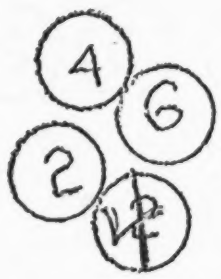


Say, "NOW I'M GOING TO TAKE THE BOTTOM ROW AWAY AND ASK YOU TO PUT THEM BACK IN A SERIES JUST LIKE THE TOP CUPS.

Mix up the bottom row and say, "NOW YOU PUT THESE CUPS IN A SERIES LIKE THE TOP ROW."

Item 6.

Fill cups with each of the following numbers of marbles: 1, 2, 2, 2, 3, 4, 6.



Present four cups to the S according to the pattern in Fig. Q 6.

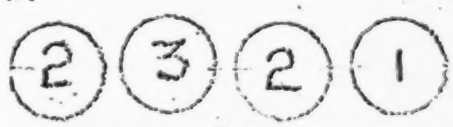


FIG Q6

Say, "LOOK AT THIS SERIES OF CUPS. NOTICE THE NUMBER OF MARBLES IN EACH CUP. IN A MINUTE I'LL GIVE YOU FOUR MORE CUPS AND ASK YOU TO PUT THEM IN A SIMILAR SERIES. READY?"

Give the S the remaining cups and say, "NOW YOU PUT THESE CUPS IN A SERIES LIKE THESE (pointing). START YOUR TWO RIGHT HERE." (pointing to a space just beneath the top row).

If necessary, coach the S saying, "WHERE WOULD THIS CUP (two marbles) GO?"

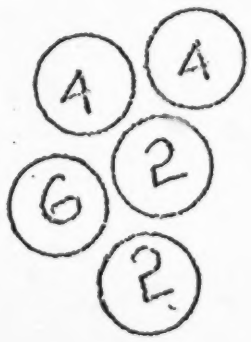
If the S doens't know, place the cup (two marbles) beneath the cup with two marbles saying, "THIS CUP GOES HERE. NOW YOU FINISH THE SERIES."

Item 7

Fill cups with each of the following numbers of marbles: 1, 1, 2, 2, 2, 2, 3, 4, 4, 6.

Present four cups to the S according to the pattern in Fig. Q 7.

S



E

FIG Q7

Say, "LOOK AT THIS SERIES OF CUPS. NOTICE THE NUMBER OF MARBLES IN EACH CUP. IN A MINUTE I'LL GIVE YOU FIVE MORE CUPS AND ASK YOU TO PUT THEM IN A SIMILAR SERIES."

Give the S the remaining cups and say,"NOW YOU PUT THESE CUPS IN A SERIES JUST LIKE THESE (pointing). Start your row right here (pointing)."

Item 8. Fill cups with each of the following numbers of marbles: 1,1,2,2,2,2,3,3,4,4,6,6,

Present five cups to the S according to the pattern in Fig. Q 8.

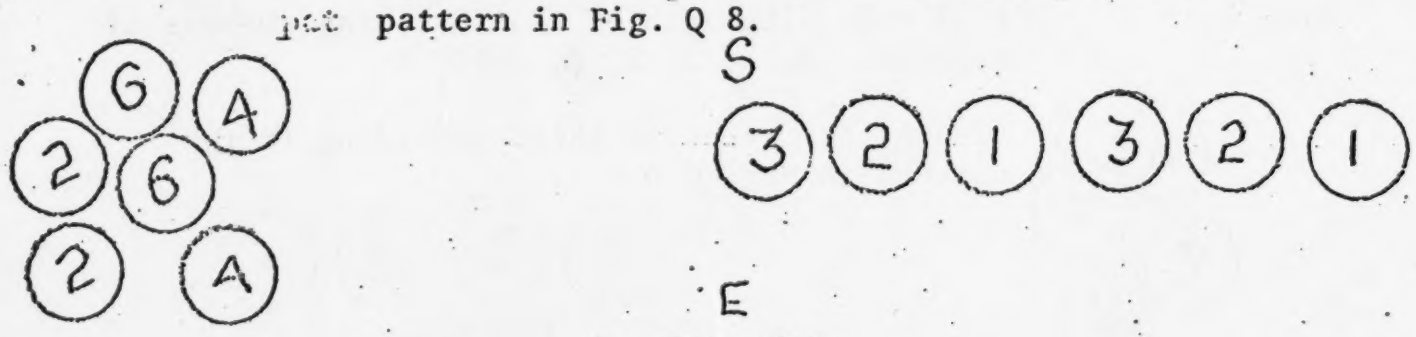


FIG Q8

Say, "LOOK AT THIS SERIES OF CUPS. NOTICE THE NUMBER OF MARBLES IN EACH CUP. IN A MINUTE I'LL GIVE YOU SIX MORE CUPS AND ASK YOU TO PUT THEM IN A SIMILAR SERIES."

Give the S the remaining cups and say,"NOW YOU PUT THESE CUPS IN A SERIES JUST LIKE THESE (pointing). Start your row right here (pointing)."

INTERPERSONAL CONTENT

Materials: Eight sets of 3 x 5 cards.

Discontinue: Following a score of one or less on two consecutive items.

Directions:

Demonstration: Select Set 1, "Boy in the Rain"

Place the cards Before S in accordance with Fig. I 1.

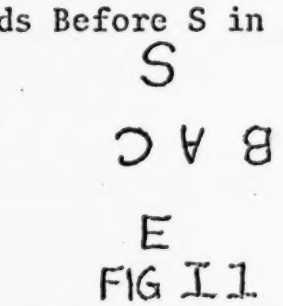


FIG I 1.

Say, "LOOK AT THESE PICTURES. THEY TELL A STORY ABOUT SOMETHING THAT HAPPENED TO A BOY BUT THEY'RE IN THE WRONG ORDER. WATCH ME WHILE I PUT THE CARDS IN ORDER TO TELL A STORY."

Choose card A and say, "THIS CARD WOULD COME FIRST BECAUSE IT SHOWS THE FIRST THING THAT HAPPENED IN THE STORY. THE BOY WAS ABOUT TO GO OUT IN THE RAIN WITHOUT A COAT. I'LL PUT THE CARD HERE (to the S's left beneath the initial demonstration) TO SHOW IT'S FIRST IN THE STORY."

Choose card B and say, "THIS CARD WOULD COME NEXT BECAUSE IT SHOWS WHAT HAPPENED NEXT IN THE STORY. THE BOY'S MOTHER HELPED HIM PUT HIS COAT ON. I'LL PUT THIS CARD HERE (next to card A) TO SHOW IT COMES NEXT IN THE STORY."

Choose card C and say, "THIS CARD WOULD COME NEXT BECAUSE IT SHOWS WHAT HAPPENED LAST IN THE STORY. THE BOY HAS HIS COAT ON AND IS GOING OUT IN THE RAIN. I'LL PUT THIS CARD HERE (next to card B) TO SHOW IT COMES LAST IN THE STORY." (Fig. I 2 illustrates the proper order at the end of the demonstration).

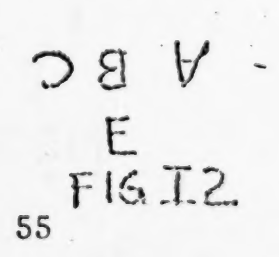


FIG I 2.

Item 1: Say, "NOW I'M GOING TO MIX UP THE CARDS AND ASK YOU TO PUT THEM IN ORDER TO TELL THE STORY."

Place card A to the S's left and the other two cards to the S's extreme right.

Say, "THIS CARD (pointing to A) BEGINS THE STORY. NOW YOU PUT THESE CARDS (pointing to B and C) IN ORDER TO FINISH TELLING THE STORY."

If necessary, say, "WHERE WOULD THIS CARD (B) GO?"

If the S doesn't know, place card B next to card A and say, "IT GOES HERE. NOW YOU PUT THIS CARD (C) WHERE IT GOES TO FINISH THE STORY."

Item 2: Select Set 2, "Baseball."

Place the cards before the S in accordance with Fig. I 3.

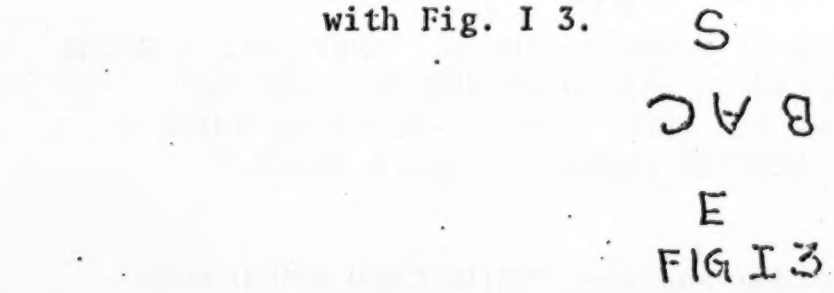


FIG I 3

Say, "LOOK AT THESE PICTURES. THEY TELL A STORY BUT THEY'RE IN THE WRONG ORDER. YOU PUT THEM IN ORDER SO THEY'LL TELL A STORY."

If necessary, coath the S, saying, "WHICH CARD WOULD COME FIRST IN THE STORY?"

IF the S doesn't know, pick up card A, place it to the S's left and say, "THIS CARD COMES FIRST IN THE STORY. NOW YOU PUT THESE TWO CARDS IN ORDER TO FINISH THE STORY."

Item 3: Select Set 3, "Falling"

Place the cards before the S in accordance with Fig. I 5.

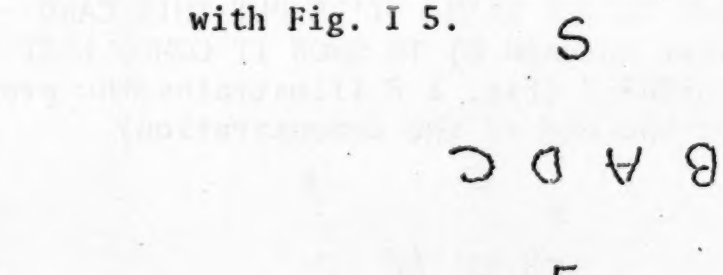


FIG. I 5

Say, "LOOK AT THESE PICTURES. THEY TELL A STORY BUT THEY'RE IN THE WRONG ORDER. YOU PUT THEM IN ORDER SO THEY'LL TELL A STORY."

Item 4: Select Set 4, "Sharing".

Place the cards before the S in accordance with Fig. I 5.

Repeat the directions for Item 3.

Item 5: Select Set 5, "The Sore Tooth."

Place cards A and F before the subject in accordance with Fig. I 6.

FIG. I 6

Say, "THESE CARDS MARK THE BEGINNING AND END OF A STORY."

Hand the S cards B - E in a stack.

Say, "THESE CARDS TELL THE MIDDLE OF THE STORY. YOU PUT THEM IN BETWEEN THE FIRST CARD (pointing) AND THE LAST CARD (pointing) TO COMPLETE THE MIDDLE OF THE STORY. PUT YOUR CARDS IN ORDER BETWEEN HERE (pointing) AND HERE (pointing) TO TELL THE STORY."

Item 6: Select Set 6, "Shaping."

Place the cards before the S in accordance with Fig. I 7.

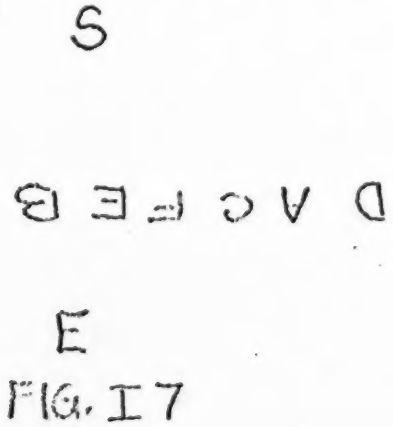


FIG. I 7

Say, "LOOK AT THESE PICTURES. THEY TELL A STORY, BUT THEY'RE IN THE WRONG ORDER. YOU PUT THEM IN ORDER SO THEY'LL TELL A STORY."

Item 7. Select Set 7, "Sleepy".

Place the cards before the S in accordance with Fig. I 7.

Repeat the directions for Item 6.

Item 8. Select Set 8, "Jealousy".

Place the cards before the S in accordance with Fig. I 8.

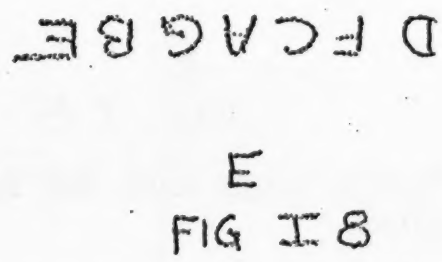


FIG I 8

Repeat the directions for Item 6.

Verbal Content

Materials: Four 8½ x 11" line drawings

Discontinue: Following a score of 1 or less on two consecutive items.

Directions:

Demonstration: Present picture A, "Scolding" to the S. Say "LOOK AT THIS PICTURE. I'M GOING TO TELL YOU A STORY ABOUT THE CHILDREN IN THE PICTURE. NOTICE THAT MY STORY WILL HAVE A BEGINNING, A MIDDLE AND AN END. IT WILL TELL WHAT HAPPENS FIRST, WHAT HAPPENS SECOND, AND WHAT HAPPENS THIRD."

Say, "THE GIRL AND BOY WERE WALKING ALONG THE STREET AND THEY MET A DOG. THE DOG SNIFFED AT THEIR FEET. THEY TOOK HIM HOME TO THEIR MOTHER."

Say, "IN THE BEGINNING OF THE STORY, THE GIRL AND BOY WERE WALKING DOWN THE STREET AND MET A DOG. IN THE MIDDLE OF THE STORY, THE DOG SNIFFED AT THEIR FEET. IN THE END OF THE STORY, THEY TOOK HIM HOME TO THEIR MOTHER."

Say, "THE FIRST THING THAT HAPPENED WAS THE GIRL AND BOY WERE WALKING AND MET A DOG. THE SECOND THING THAT HAPPENED WAS THE DOG SNIFFED AT THEIR FEET. THE THIRD THING THAT HAPPENED WAS THEY TOOK HIM HOME TO THEIR MOTHER."

Item 1: Continue to use Picture A,"Scolding." Say, "NOW I WANT YOU TO TELL ME A STORY ABOUT THE PICTURE. YOU CAN USE MY STORY OR MAKE UP A STORY ALL YOUR OWN. REMEMBER THAT A STORY HAS A BEGINNING, A MIDDLE AND AN END."

If necessary, the examiner may prompt the child saying, "WHAT IS THE FIRST THING THAT HAPPENED IN YOUR STORY?" E may continue to prompt the S to generate additional scores to a total of three.

Item 2: Present card B, "Kicking the Can," to the S. Say, "HERE IS ANOTHER PICTURE. LET'S PLAY LIKE THIS IS THE BEGINNING OF A STORY. YOU TELL ME WHAT MIGHT HAPPEN RIGHT AFTER THE SCENE IN THE PICTURE."

If S responds appropriately, say "GOOD. NOW TELL ME WHAT MIGHT HAPPEN NEXT IN THE STORY."

Item 3: Present Picture C, "The Fallen Doll," to the S. Say, "HERE IS ANOTHER PICTURE. LET'S PLAY LIKE THIS IS THE MIDDLE OF A STORY. TELL ME WHAT MIGHT HAVE HAPPENED BEFORE THE SCENE IN THE PICTURE AND WHAT MIGHT HAPPEN JUST AFTER THE SCENE IN THE PICTURE."

E may prompt the S saying; "TELL ME WHAT HAPPENED JUST BEFORE THEY PICTURE" and "TELL ME WHAT HAPPENED JUST AFTER THE PCITURE."

Item 4: Present Picture D, "The Parade," to the S. Say, "HERE IS STILL ANOTHER PICTURE. LET'S PLAY LIKE THIS PICTURE SHOWS THE END OFA STORY. I WANT YOU TO TELL ME TWO THINGS THAT MIGHT HAVE HAPPENED BEFORE THE SCENE IN THE PICTURE."

E may prompt the S saying, "TELL ME WHAT HAPPENED JUST BEFORE THE PICTURE" and "WHAT HAPPENED JUST BEFORE THAT."

Item 5: Say, "NOW I WANT YOU TO TELL ME A STORY ALL BY YOURSELF. YOU CAN MAKE UP ANY STORY YOU LIKE. REMEMBER THOUGH THAT THE STORY MUST HAVE A BEGINNING, A MIDDLE, AND AND END. IT SHOULD TELL WHAT HAPPENDS FIRST, SECOND, AND THIRD."

The S must introduce the idea of the story; however, after the initial idea is presented by S, the E may prompt the S to elicit three scenes.

Item 6: Say, "NOW I WANT YOU TO TELL ME A STOY ABOUT SOMETHING YOU LIKE TO DO. WHAT DO YOU LIKE TO DO BETTER THAN ANYTHING ELSE?" Encourage a response from S. "NOW TELL ME A STORY ABOUT HOW YOU _____."

E may prompt the S to generate three scenes.

Item 7: Say, "NOW I WANT YOU TO TELL ME A STORY ABOUT SOMETHING YOUR MOTHER WOULD LIKE FOR YOU TO DO. WHAT IS SOMETHING YOUR MOTHER WANTS YOU TO DO?" Encourage a response from S. "NOW TELL ME A STORY ABOUT HOW YOU WOULD _____?"

E may prompt the S to generate three scenes.

Item 8: Say, "NOW I WANT YOU TO TELL ME A STORY ABOUT WHAT WILL HAPPEN WHEN YOU LEAVE THIS ROOM. WHAT WILL YOU DO?" Encourage a response from S. "NOW TELL ME A STORY ABOUT _____."

E may prompt the S to generate three scenes.

Scoring Criterion

Concrete Subtest

Subject's responses to each item are scored 1 or 0. A 1 indicates that the subject produced the designated pattern of sticks. A 0 indicated that the subject had one or more sticks out of sequence.

Quantitative Subtest

Subject's responses are scored 1 or 0. A 1 indicated that the subject arranged the cups in the proper order. A 0 indicates that at least one cup was out of sequence.

Interpersonal Subtest

Subject's responses are scored 1 or 0. A 1 indicated that the subject arranged the cards in correct alphabetical sequence (see letters on back of cards on each set). A 0 indicates that at least one card was out of sequence.

Verbal Subtest

Subject's responses to each item are scored 1 or 0. A 1 indicated that 3 scenes can be identified in the subject's story. A 0 indicates less than 3 scenes could be identified. A scene is defined as a situation in which there is no change of place or activity. If persons change place or activity, a new scene is generated. A list of objects or people in a picture or situation is not considered a story.

APPENDIX B

Means and standard deviations of post test scores of each treatment group in the Seriation Skills Project.

Test	Group I $\bar{X}$	I sd.	II $\bar{X}$	II sd.	III $\bar{X}$	III sd.	IV $\bar{X}$	IV sd.
Concrete	5.7	1.9	5.3	1.7	4.5	2.3	5.1	1.7
Quantitative	5.0	1.5	4.9	1.6	4.8	2.1	4.2	1.6
Interpersonal	3.7	1.3	3.5	1.5	3.4	1.3	3.5	1.6
Verbal	4.9	2.4	4.4	2.3	4.5	1.1	3.7	2.5
Total	19.3	5.2	14.5	5.1	17.4	5.8	15.9	5.8

APPENDIX C

The distribution of subjects from each classroom to treatment groups.

Experimental Condition			School Classroom I a	I b	I c	II a	II b	II c	III a	III b	III c	III d	
0	X	0	5	10	10	10	10	10	10	15	15	10	n = 105
	X	0	5	5	5	5	5		5			5	n = 35
0		0	2	4	3	4	5	4	5	5	5	5	n = 42
		0	2	3	5	5	5	4	5	5	5	5	n = 44

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